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Yellow Fever Institute, Bulletins Nos. 1, 2, 3, 4, 5, 6, and 7.

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, *Surgeon-General.*

BULLETIN

ON .

Organization and Progress of the Institute

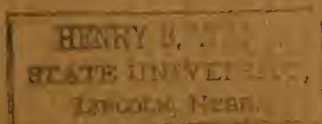
AND

BULLETINS FROM SECTION A—HISTORY AND STATISTICS
SECTION C—TRANSMISSION; AND SECTION D—QUAR-
ANTINE MANAGEMENT AND TREATMENT.

MARCH, 1902.

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Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, *Surgeon-General.*

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NOTE.

Though combined, for the sake of economy, in one volume, the several bulletins herein published have been prepared with a view to binding at the end of the calendar year with other bulletins which are to follow. While the bulletin numbers are consecutive and without regard to section, it is proposed in the annual volume to so arrange them that the bulletins relating to each section will be bound together under the section headings, namely, Sections A, B, C, and D.

YELLOW FEVER INSTITUTE,

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN,
SURGEON-GENERAL M. H. S.,
Chairman.

H. D. GEDDINGS,
PASSED ASSISTANT SURGEON, M. H. S.,
Secretary.

BULLETIN No. 1.

REPORT ON ORGANIZATION AND PROGRESS OF THE INSTITUTE.

(ABSTRACT OF MINUTES.)

MARCH, 1902.

YELLOW-FEVER INSTITUTE OF THE U. S. MARINE-HOSPITAL SERVICE.

In view of the importance of the definite determination of the cause, means of spread, history and statistics, and quarantine management and therapeutic treatment of yellow fever, it was determined to form within the U. S. Marine-Hospital Service an Institute for the investigation of these problems and other kindred topics which might be found to have a bearing on the questions as investigations proceeded.

The prime object of the organization is to stimulate the spirit of scientific investigation among officers of the corps and to secure the cooperation of all who are interested in the solution of these very important questions.

On September 13, 1901, a plan of organization was submitted to the honorable Secretary of the Treasury, which, receiving his approval, led to the organization of the Institute, with an executive board, constituted as follows :

CHAIRMAN OF THE INSTITUTE.

The SURGEON-GENERAL OF THE U. S. MARINE-HOSPITAL SERVICE.

SECRETARY.

Passed Asst. Surg. H. D. GEDDINGS, M. H. S., in Charge of the Bureau Division of Scientific Research.

CHAIRMEN OF SECTIONS.

SECTION A—*History and Statistics*.—Chairman, Surg. George T. Vaughan, M. H. S., In Charge of Bureau Division of Sanitary Reports and Statistics.

SECTION B—*Etiology*.—Chairman, Passed Asst. Surg. M. J. Rosenau, M. H. S., Director of the Hygienic Laboratory, M. H. S.

SECTION C—*Transmission*.—Chairman, Surg. J. H. White, M. H. S., In Charge of Bureau Division of Domestic Quarantine.

SECTION D—*Quarantine and Treatment*.—Chairman, Surg. R. M. Woodward, M. H. S., In Charge of Bureau Division of Foreign Quarantine and Immigration.

October 11, 1901.—The first meeting of the executive board, composed under the terms of the plan of organization of the above chairman, secretary and chairmen of sections, was held, all the members being present, and the plans for securing information and carrying out the plans of the Institute were discussed. It was agreed without dissenting voice, that it was necessary to investigate all theories as to the origin and spread and methods of transmission of yellow fever.

At a meeting held October 19, 1901, Professors Welch, Osler, Abbott, McFarland, Flexner, Barker, Vaughan (Victor C.), John Guitéras, and Drs. Ravenel, Flint, Theobald Smith, and Carlos Finléy were proposed for membership in the Institute and duly elected.

The secretary was instructed to send to the chief quarantine officers of Cuba and Porto Rico additional copies of the plan of organization of the Institute, and to request them to submit for consideration as possible members of the Institute the names of persons within their territory whom it was thought might from taste or previous work be valuable members.

The secretary was also instructed to prepare a form of invitation to pathologists and bacteriologists to enroll themselves as members of the Institute, and to prepare and submit for approval a form of invitation to foreign scientists, to unite themselves with the Institute as corresponding members.

The subject of the preparation and publication of bulletins was discussed, but action was deferred.

The Institute was informed of the appointment by the Orleans Parish Medical Society, of New Orleans, La., of a commission to investigate and report upon the subject of the mosquitoes of New Orleans and vicinity, and their relation to the questions of malaria and yellow fever.

The secretary was directed to extend invitations to membership to all State health officers, or secretaries of State boards of health.

It was resolved to communicate with the Surgeon-General of the United States Army and Navy, with a view of enlisting the aid and cooperation of medical officers of the Army and Navy.

November 5, 1901.—At the meeting of the executive board of the Institute the secretary reported that up to this time replies as to membership in the Institute had been received from 36 officers of the Marine-Hospital Service, and that replies accepting membership had been received from 64 others, and that among these were Dr. Benjamin Lee, president of the State board of health of Pennsylvania, and Dr. John S. Fulton, president of the State board of health of Maryland.

The chairman called attention to the fact that in the library there were reports showing that in the past there had been use made of petroleum upon the streets and in the gutters of New Orleans and Mobile, with apparently no very well-defined end in view, but, as the results

showed an escape from a visitation of yellow fever subsequent to the procedure, he thought that the matter had some significance.

The chairmen of the various sections then made reports upon the plans of organization of work in their sections, which they stated were tentative, and which were received as information.

Dr. Rosenau invited attention to the fact that under the topic of the transmission of yellow fever the mosquito alone had received attention. He proposed the following additional topic, viz, "Can the disease be conveyed by any other insect, such as the flea, fly, bedbug, etc."

November 12, 1901.—At a meeting of the executive board, Dr. Rosenau reported that Professor Howard had informed him that he was at present engaged in making a study of the geographical distribution of mosquitoes in the United States, and would be glad to communicate his results when completed, for the use of the Institute.

Letters were then read from the Surgeons-General of the United States Army and Navy, acknowledging receipt of communications from the Institute, and giving assurance of their interest in its work, and pledging themselves to cooperation in the matter of furnishing reports, etc.

The secretary was directed to extend invitations to membership to the president and secretary of the American Medical Association, and to the president and secretary of the section on hygiene and sanitary science of the said association, also the members of the committee on the etiology of yellow fever of the American Public Health Association.

The chairman then read a letter which he had prepared for the approval of the Secretary of the Treasury, dissolving the former yellow fever commission of the Marine-Hospital Service, the Institute superseding it.

The secretary then read a letter from Dr. Joseph Y. Porter, the State health officer of Florida, in relation to the influence of the mosquito in the spread of yellow fever. He also invited attention to certain epidemic incidents in Jacksonville and Key West, and suggested inquiry. The matters were discussed, but no definite conclusion was arrived at.

The secretary was directed to prepare a syllabus showing the status of the question of the transmission of yellow fever from the point of view both of the mosquito and fomites, the syllabus to be arranged in the form of parallel columns, and showing the arguments and evidence pro and con, adduced for each contention.

The chairman of Section A presented a map which he suggested for use in the preparation of maps showing the prevalence of yellow fever in the United States, and also for showing graphically the area of infectible and noninfectible territory.

A letter was read from Acting Assistant Surgeon Hodgson, expressing a desire to be stationed in Vera Cruz for the purpose of conducting experiments in the treatment of yellow fever. It was determined to comply with the request of Dr. Hodgson at the earliest possible moment.

An offer of a paper by Surgeon Carter on the infection of ships by yellow fever was then read, and Dr. Carter's offer was accepted.

December 3, 1901.—At a meeting of the Executive Board letters were read from Asst. Surg. R. H. von Ezdorf and Passed Asst. Surg. G. M. Guitéras, nominating certain gentlemen as members of the Institute. Upon motion they were elected as members, and the secretary was instructed to so notify them.

A report was received from Acting Asst. Surg. Owen W. Stone, relative to an epidemic of yellow fever at Greenville, Miss., in 1878, supposed to have originated from infected baggage from New Orleans.

The chairman of Section B offered to the Institute for use as a bulletin a report by Assistant Surgeon Grubbs on "Mosquitoes in Baggage," which the secretary was ordered to prepare for publication.

January 21, 1902.—A proposition was received from Drs. O. L. Pothier and George E. Beyer, of New Orleans, La., offering to place themselves at the disposal of the Institute and the Service, with a view of continuing the work which they had already done, as members of the Orleans Parish Mosquito Commission, said work to be in the interest and on behalf of the Institute of which they are members.

Discussion followed, in which it was agreed that it would be advantageous to engage the services of these gentlemen, and to associate with them Asst. Surg. H. B. Parker, M. H. S., the three to constitute a working party, who would proceed to some point in Mexico or South America, when and where yellow fever might make its appearance, for the purpose of continuing the work inaugurated by the New Orleans commission. It was directed that Drs. Pothier and Beyer be communicated with, and a definite proposition obtained from them.

It was further agreed that it would be advisable to station an officer for purposes of observation in Habana, Cuba, and the Surgeon-General M. H. S., was requested, if possible, to detail Asst. Surg. D. H. Currie for the purpose, he having received special training which would fit him for the detail.

Attention was also called to the presence of the French commission for the investigation of the cause of yellow fever, which was at present located at Petropolis, in Brazil.

It was further agreed that it would be advisable to keep informed as to the prevalence of yellow fever on the west coast of Africa (Senegal), with a view to dispatching another worker or party to that point.

Information was also elicited to the effect that the services of Acting Assistant Surgeon Gregory, who is now undergoing instruction in the Hygienic Laboratory, and whom it was intended to dispatch to Rio de Janeiro, would be of value in enabling him to report upon such transactions of the French commission as might come to his notice.

A report was read from the consul at Marseille, France, showing the quarantine management of yellow fever at that port, and giving statistics of the disease for past years.

January 29, 1902.—At a meeting of the executive board, the secretary read a communication received from Drs. Pothier and Beyer of New Orleans, in which they expressed a perfect willingness to have Dr.

Parker associated with them, and in which they also proposed terms, etc. These terms and proposed arrangements being considered reasonable and advantageous, it was resolved that the Surgeon-General Marine-Hospital Service be requested to have Drs. Pothier and Beyer appointed temporary acting assistant surgeons for the purpose, and on the terms named by them. The question of the publication of bulletins was again brought before the meeting, and it was decided informally that an effort should be made to prepare a general bulletin showing the progress of organization, and that this should be succeeded by special bulletins, showing the work of the various sections, material for some of these special bulletins being now in the hands of the secretary and further additions being promised.

February 14, 1902.—At a meeting held this day the names of Dr. Pedro J. Salicrup and Dr. Antonio Molina, of Ponce, P. R., were submitted for membership by letter from Asst. Surg. W. W. King. and upon motion duly seconded they were elected to membership. Upon motion duly seconded, Dr. George H. F. Nuttall, of Cambridge, England, was invited to membership in the Institute, and the secretary was instructed to convey notice of the invitation to him by letter.

Upon motion made and duly seconded, the following foreign scientists were invited to enroll themselves as corresponding members of the Institute: Drs. N. del Rio, Manuel Iglesias, and Z. Molina, of Vera Cruz, México; Prof. Guiseppe Sanarelli, of the University of Bologna, Italy; Dr. Catalan, chief of quarantine, of Marseille, France; Professor Proust, Inspector General of the Sanitary Service of the Republic of France; Professor Wurtz, of the School of Medicine, Paris, France; Dr. E. Liceaga, President of the Superior Board of Health of Mexico; Dr. Frederick Montizambert, Director General of Public Health, Ottawa, Ontario; Dr. W. Havelburg, of Berlin, Germany; Prof. R. Blanchard, of the Faculty of Medicine, Paris, France, and Professor Dunbar, of the Hygienic Institute, Hamburg, Germany.

Dr. Vaughan then reported that he had received from Assistant Surgeon Glover, at Boston, Mass., a contribution on the question "Why Did Not New Orleans have Yellow Fever in Early Times, while Boston Did," and suggested its publication as a special bulletin from Section A, which was so ordered. He further reported that he was in receipt of two papers from Passed Asst. Surg. J. M. Eager, at Naples, Italy, one being a general history of yellow fever in Europe, the other a history of the disease in Portugal, with a promise of further contributions on the subject of the disease in other countries in Europe. He suggested, and it was ordered, that these be published also as special bulletins.

Surgeon White reported that as chairman of Section C he was in receipt of a contribution from Surg. H. R. Carter on the subject of the infection of ships by yellow fever—the result of personal observations. After considerable discussion it was agreed that the article should be offered to a medical journal for publication, and that it should subsequently appear as a special bulletin of the Institute.

The chairman of Section D reported that a letter had been addressed through the Treasury Department to the Department of State, requesting that the consuls in various Central and South American districts be requested to give early telegraphic notice of the appearance of yellow fever in their localities, in order that the Institute might make proper arrangements to dispatch its working parties to the scene of the outbreak.

February 26, 1902.—The secretary reported that in the matter of the invitations to foreign scientists to enroll themselves as corresponding members, it had been deemed expedient by the Surgeon-General to request the Secretary of the Treasury to ask the opinion of the Department of State as to the propriety of issuing invitations to such gentlemen, several of whom were actually officials under their various governments. The matter was therefore held in abeyance, pending the receipt of this decision, but a reply having been received from the Secretary of State, stating that the proposed action was in accord with official propriety, the invitations were subsequently duly dispatched.

The secretary further reported that a reply had been received from the Department of State, saying that in accordance with request, the consuls at Rio de Janeiro, Santos, and Vera Cruz had been instructed to cable information of the first appearance of yellow fever in their districts.

The Surgeon-General was requested to take the necessary preliminary steps toward having Drs. Beyer and Pothier, of New Orleans, nominated in due form as acting assistant surgeons, in order that there might be no delay in dispatching them when an outbreak of yellow fever made the employment of their services desirable.

A discussion followed on the most recent announcement by Drs. Reid and Carroll of their work on the etiology of yellow fever, who announced as a result of their experiments, that the causative organism of yellow fever was ultra-microscopical.

While all officers of the Marine-Hospital Service are *de facto* members, at this time the Institute has as members 55 officers of the Marine-Hospital Service, who have formally given notice of their cooperation. Assurances of cooperation have been received from the Surgeons-General of the United States Army and Navy, and in addition to those invited and enrolled as corresponding members, over 100 invitations to membership have been issued and acknowledged, including bacteriologists and pathologists, secretaries and executive officers of State and local boards of health, the president and secretary of the American Medical Association, and the chairman and secretary of the section of hygiene and sanitary science of the same association, members of the committee on the etiology of yellow fever of the American Public Health Association, and physicians in all parts of the United States, Cuba, and Porto Rico.

The names of all those elected to membership are not included in the foregoing transcript, but in a subsequent bulletin there will appear a full list of the regular and corresponding members of the Institute.

YELLOW FEVER INSTITUTE,

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, Surgeon-General.

BULLETIN NO. 2.

Section A.—HISTORY AND STATISTICS.

Surg. GEORGE T. VAUGHAN, Chairman of Section.

YELLOW FEVER—WHY DID NOT NEW ORLEANS HAVE INVASIONS OF THE DISEASE IN EARLY TIMES, WHILE BOSTON DID ?

By M. W. GLOVER, *Assistant Surgeon, M. H. S.*

MARCH, 1902.

YELLOW FEVER—WHY DID NOT NEW ORLEANS HAVE IT IN EARLY TIMES, WHILE BOSTON DID ?

In the consideration of this subject it is necessary, first to ascertain the date of the primary visitation of yellow fever in the two cities. After a careful examination of the authorities, one arrives at the conclusion that the first undoubted visit of yellow fever to Boston was in 1798. In 1693 the following circumstances, quoted from Hutchinson, have given rise to the statement that yellow fever prevailed in that year in Boston. An English fleet had been ordered from the West Indies to Boston to cooperate with land forces in an attack on Quebec.

Before Sir Francis Wheeler came to Boston with the fleet, June 17, 1693, he had buried 1,300 out of 2,100 sailors, and 1,800 out of 2,400 soldiers. * * * The distemper, which had been in the fleet spread to Boston, and was more malignant even than the smallpox had been or any other epidemical sickness which had been in the country before.

Chief Justice Sewall, in his diary, also remarks on the deaths of several persons from the "sickness of the fleet."

On the other hand Cotton Mather in his *Magnalia*, says :

There was an English fleet of our good friends, with a direful plague aboard, intended hither. Had they come, as they intended, what a horrible desolation had cut us off, let the desolate places that some of you have seen in the colonies of the South declare unto us ! And that they did not come. was the signal hand of Heaven.

Noah Webster, in his *History of Pestilential and Epidemic Diseases* (1799), arrives at the following conclusion :

From this authentic history, written by a contemporary clergyman, we infer that Hutchinson must have made a mistake. Sir Francis Wheeler's fleet arrived at Boston most dreadfully infected, but no disease was propagated in Boston. Some other fleet, it seems, had introduced the disease into "a colony of the South," perhaps Newport or New York, but I have no information on the subject.

Lyman Spalding, in *Reflections on Yellow Fever Periods* (1819), states that the first appearance of yellow fever in Boston was on the 25th of August, 1796, "in a family at the southeasterly part of the town, near a considerable extent of flats, which are daily exposed for some hours to the action of the sun. No mention is made of importation either by Dr. Warren or by Dr. Brown. Public opinion did not even accuse any vessel of having imported it." Noah Webster says that in 1796 the disease appeared in Boston, but was not general or severe. "It spread only in a small part of the town adjoining the water." This occurrence, if of true yellow fever, was undoubtedly sporadic.

This brings us, then, to the first undoubted epidemic of yellow fever in Boston, which occurred in 1798. With regard to the origin of this epidemic, the following statement is made in Tytler's *Treatise on Plague and Yellow Fever* (1799).

The origin of the fever at Boston has, as usual, been disputed, but the common opinion is that it was generated. It now appears, however, that, though there are very strong reasons for supposing it to have originated in the place, there are others equally strong for believing that it was imported. It is ascertained that a vessel, on board which persons had died with the yellow fever, lay in the neighborhood of the family first seized with the disease in 1798.

Dr. Warren dismisses the subject thus: "No person could produce any evidence of importation of this disease." Noah Webster says that the fever showed most violent effects in the region of Fort Hill, and suggests that we may find the cause in the very extensive flat between Boston and Dorchester Point, which is uncovered at low water. In common with all the other cities afflicted by epidemics from 1793 to 1804, yellow fever in Boston began in the most filthy part of the town. Mill Pond, one of the foci of the disease, is thus described by Samuel Brown :

This pond is the common receptacle of a great number of dead dogs, cats, and small animals, besides large quantities of putrid meat, fish, and vegetables. There also empty the sewers and drains from vaults and cellars of the buildings surrounding the place. This pond was frequently, during the summer, deprived of its waters, and its naked surface exposed to the excessive heat of the sun.

Fever prevailed until the latter part of October, when a severe northeaster, continuing for three days, followed later by a heavy frost, completely checked the disease.

That our forefathers in medicine were puzzled by the eccentricities of this disease there is abundant proof in the literary remnants of a bitter controversy as to whether yellow fever was imported or domestic,

whether it was contagious or noncontagious. One thing is to be borne in mind in considering the sporadic cases of the years previous to 1798, and that is the possibility of a mistaken diagnosis. We have positive proof that malarial fevers were common in New England in the early days, though now malaria is no longer endemic in this region, possibly due to the filling in of stagnant ponds and improved drainage facilities. In view of all the circumstances we are justified in considering 1798 as the earliest appearance of yellow fever in Boston.

Let us now consider New Orleans. This city was founded by Bien-ville in 1718, though it was not until 1722 that the capital was finally established there. It was not for many years after the settlement of Louisiana that the attention of its people was given to the development of its agricultural resources, and commerce with other countries entered into. Yellow fever seems to have been unknown in New Orleans until 1769, when an outbreak occurred, which was not general and appears to have been sporadic. In one place a statement is made that yellow fever was introduced in this year by a British vessel from the coast of Africa with a cargo of slaves. No confirmation of this statement could be found, however. In 1796, according to Chaillé, occurred the first epidemic of yellow fever, and he considered the digging of the Carondelet Canal, begun in 1794, as a predisposing factor. In a work entitled, *Travels in Louisiana and the Floridas*, published in 1802, it is stated that yellow fever was unknown in New Orleans prior to 1796, and "it is the general opinion that the yellow fever at New Orleans was imported from the United States of America. * * * It is thought to have its origin from the fever that committed its ravages at Philadelphia in 1793, and that it was brought to New Orleans by the Americans themselves," who engaged the greater part of the trade of New Orleans.

From the foregoing it will be seen that, disregarding all sporadic cases, Boston had its first epidemic in 1798, New Orleans in 1796. Therefore, there was little, if any, difference in the time of the advent of yellow fever in both cities. It seems that both were touched by the great wave of pestilence that swept over the country from 1793 to 1804. In Boston the disease was as seed that fell in stony places and, having no root, withered away; while in New Orleans it was as seed that fell on good ground and brought forth fruit an hundredfold, bearing its yearly crop of deaths and desolation.

If we consider sporadic cases, however, the conclusions we arrive at are not materially different. In 1691 and 1693, when Boston is reputed to have had yellow fever, New Orleans did not have it for only one reason, and that was the nonexistence of New Orleans. From 1718, the date of New Orleans' birth, until 1796, the first epidemic in that city, Boston was equally free from the visits of the pestilence.

YELLOW FEVER INSTITUTE,

Treasury Department, U. S. Marine-Hospital Service.

WALTER WYMAN, Surgeon-General.

BULLETIN No. 3.

Section A.—HISTORY AND STATISTICS,

Surg. GEORGE T. VAUGHAN, Chairman of Section.

YELLOW FEVER IN EUROPE—A GENERAL HISTORICAL REVIEW.

By J. M. EAGER. *Passed Assistant Surgeon, M. H. S.*

MARCH, 1902.

YELLOW FEVER IN EUROPE.

Although the fact is well known that at various times yellow fever has gained a foothold in Europe, no adequate idea can be had of its widespread prevalence at many places where it has been introduced except by a careful review of the literature of the disease. The extent of some of these accidental epidemics of yellow fever occurring outside of the regions of its periodic prevalence is made evident when it is remembered that at Barcelona, Spain, during the funereal epidemic of the year 1821, approximately 25,000 persons died within five months of yellow fever, and that, at Lisbon, Portugal, during the year 1857, in an epidemic of five months' duration, there were over 13,000 persons stricken with the disease, the mortality being almost 50 per cent.

An outbreak of bubonic plague in a European city as disastrous as, for example, the yellow fever epidemics mentioned would certainly give rise to the justifiable apprehension that the disease was likely to overrun the Continent.

That the mosquito conveys the yellow fever infection, according to the theory of Finlay, appears to be satisfactorily proved. In event of the fact being further established that the mosquito is the sole agent in the transmission of the infection of yellow fever from man to man, it would be interesting to know what particular mosquito was instrumental in the spread of the disease after its introduction into European ports. From the review of the literature of the subject, and such inquiries as have been made in the preparation of this writing, it has

been impossible to determine whether the *Culex fasciatus* of American authors is exactly represented in the description of the European mosquitoes. *Stegomyia teniati* does not appear in any accessible European nomenclature. A. Lutz, director of the municipal bacteriological laboratory of Sao Paulo, Brazil, after careful entomological examination, has determined that the South American mosquito described as *C. toeniatus* is the same as *C. fasciatus* of North America. De Gouvea states that the yellow-fever mosquito of America is the same as that occurring and named in Southern Italy as *C. elegans*, Ficalbi, and in Portugal as *C. calopus*, Hoffmannii. It does not appear, however, from the systematic revision of the culex family, made by Ficalbi in his latest work (1896), that *C. elegans*, Ficalbi, and *C. calopus*, Hoffmannii, are the same. Miegen states that *C. calopus*, occurs in Portugal. Rondani accepts the species for Italy, but does not give a full description. Ficalbi records that Stephens mentions *C. calopus* in the list of English mosquitoes, but marks it with an interrogation point. Writing of *C. elegans*, Ficalbi says that he has found this mosquito in Italy, but not in large numbers. He has described the species under the name of *C. elegans*, because, after rigorous inquiry he has been unable to identify the mosquito with any described by authors who had previously prepared classifications. Ficalbi adds that he often asks himself if, "per adventure, *C. elegans* may not be the *C. calopus* of Meigen," but is "constrained to make a separate species because of slight differences in the zoological descriptions."

In fixing upon the guilty mosquito, there is abundant variety to reckon on. Ficalbi, in the treatise mentioned, describes 60 species of mosquitoes inhabiting Europe—53 belonging to the genus *Culex*, 5 to *Anopheles*, and 2 to *Aedes*.

Should it be found on careful comparison that the American mosquito that conveys yellow fever does not correspond with any European member of the *Culex* family, there still remains the possibility that a European mosquito of a different species may perform the office of carrier of yellow fever contagion, or that stowaway mosquitoes from the Western Hemisphere accompanying pest ships might be landed in Europe, reproduce their kind for a few generations, and incidentally continue the spread of yellow fever.

Without taking into consideration the cases that have occurred on board vessels in ports and at quarantine stations, in Europe, yellow fever has at times been present in Portugal, Spain, France, the British Isles, Italy, and Austria.

The earliest authentic appearance in Europe was in 1723, at Lisbon, Portugal, an epidemic which attained great proportions. Portugal was free from the disease from that year until 1850, when there were a few cases at Oporto. In 1851 there were 57 deaths from yellow fever at Oporto. A third epidemic occurred at Oporto in 1856 and resulted in 120 cases and 63 deaths. In the year of Portugal's greatest epidemic of

yellow fever (1857) there were at Lisbon, where the first focus formed, 13,757 persons sick with the disease, of whom 5,652 died. In the neighboring city of Olivaes 112 cases of yellow fever occurred. The next year a few cases were reported in Portugal and the Azores, and since then yellow fever is said to have been absent from the country.

Spain is the European country whose yellow fever history is the most extensive. It is of practical bearing to note that often when the most rigid sanitary precautions were being taken to prevent the importation of the disease, the contagion was introduced into Spain by smugglers in surreptitious communication with suspected vessels, or clandestinely landing infected goods, thus confirming by the history of Spanish epidemics, the wisdom of the measures that have of late been taken by the Marine-Hospital Service in making a patrol of the Florida coast with a view to a surveillance of small craft from West Indian waters.

There is no accredited record of yellow fever having appeared in Spain prior to 1738, when it was imported into Cadiz from America and spread to other cities of Spain. In 1733, 1741, 1744, 1746, 1749, and 1753, epidemics of greater or lesser severity prevailed, that of 1741 causing 10,000 deaths. After more than half a century of immunity, an outbreak occurred in 1800, spread widely, and numbered 17,500 persons as its victims. The next year and the second year after, the disease renewed its ravages. In 1803, at Malaga, 6,884 persons died of yellow fever. In 1804, there perished 7,726 persons. In the latter year, the disease extended to many cities of Spain. Again, in 1808, 1810, 1811, 1812, and 1814, there were epidemics of varying virulency. At Cadiz in 1819, 40,000 cases of yellow fever were recorded with a mortality of 20 per cent. The prevalence at Barcelona in 1821 was appalling in its results. In five months, 25,000 persons died of the disease. The infection spread to other cities, killing 4,500 at Tortosa, and destroying one-half the inhabitants of Palma, capital of the Balearic Islands. In 1823 and 1829, the malady was present in Spain, but afterwards there was an interval of immunity extending to 1870. During the summer of 1870, the contagion was introduced into Barcelona and, in the months of August and September, between 25 and 40 persons fell prey each day to the disease. The latest recorded occurrence in Spain was in 1878, when yellow fever invaded the capital, Madrid, and attacked 50 persons of whom 30 died.

It is stated in an early history of the city of La Rochelle that the first importation of yellow fever into France, and consequently into Europe, was in 1700, but the record lacks scientific authority. The first properly verified occurrence was at Brest, 1802, when 23 deaths took place in the hospital of the lazaretto, and several cases broke out in the city. The same year yellow fever was present in quarantine at Marseille. At Marseille again there were cases in the city in 1821, and at Brest in the harbor in 1839. Sanitary interest, however, from a yellow fever point of view, is centered on the epidemic at Saint Nazaire, in 1861. A sailing vessel introduced the disease from Havana. The manner in which it

spread throughout the shipping of the port, infecting 7 other vessels, with a result that 40 persons fell ill of yellow fever and 23 died, has led a recent writer (de Gouvea, *Le Bulletin Medical*, October 12, 1901) to observe that the facts, in his opinion, adapt themselves perfectly to the theory of the propagation of yellow fever by mosquitoes. On different occasions, after the epidemic at Saint Nazaire, yellow fever occurred on board ships in French harbors, but did not appear ashore, except in 1870, when a seaman from a pest ship died of yellow fever in a civil hospital at Marseille.

The yellow fever history of the British Isles is limited to 5 appearances of the disease between the years of 1817 and 1865, in the harbors of Falmouth, Southampton, and Swansea.

At Leghorn, in 1804, yellow fever was introduced by a Spanish vessel from Alicante and Cadiz where the disease was epidemic. The disease prevailed at Leghorn for four months, causing not less than 700 deaths, and according to one author as many as 1900. At Torre Annunziata, a city of 20,000 inhabitants situated in the province of Naples, there was in 1883 an epidemic prevalence of a disease which was pronounced by several competent medical men to have been yellow fever. Of 13 cases presenting clinical features at least closely resembling yellow fever, 7 died. A full epidemiological account of the disease, gathered from the municipal archives of Torre Annunziata, has been prepared for the present writing. This interesting epidemic outbreak was completely lost sight of, and for the time apparently forgotten in the overshadowing gloom of the terrible cholera epidemic 1884, at Naples, on the eve of which it occurred.

The history of yellow fever in Europe closes in 1894, with the death from that disease of two seamen in a hospital at Trieste. The contagion was brought to Austria from Brazil by two sailors who landed from a pest ship at Genoa and went by land to Trieste.

In the examination of literature for the preparation of this account, it was found that the epidemiology of yellow fever is not anywhere collected in a single writing. It is scattered through many books. A comprehensive survey of the subject is of more than antiquarian interest. It has at least the value of teaching that the disease is capable of extending, under suitable conditions, and prevailing epidemically in Europe, as it did in Philadelphia and other Northern cities of the United States, a century ago.

With a view to presenting in a summary manner the epidemiology of yellow fever in Europe, this account has been prepared from the extensive and scattered literature of the subject.

YELLOW FEVER INSTITUTE,

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, Surgeon-General.

BULLETIN No. 4.

Section A.—HISTORY AND STATISTICS

Surg. GEORGE T. VAUGHAN, Chairman of Section.

YELLOW FEVER IN PORTUGAL.

By J. M. EAGER, *Passed Assistant Surgeon, M. H. S.*

MARCH, 1902.

YELLOW FEVER IN PORTUGAL.

1723. In the year 1723, yellow fever was imported into Lisbon from Brazil and, according to documents in possession of the sanitary council of the Kingdom of Portugal, this was the first appearance of yellow fever in Europe. At that time Lisbon had a population much smaller than at the period of the great epidemic of 1857. Still the number of persons said to have been taken ill with the disease and the mortality during the first epidemic were greater than in the latter. There is, however, no accessible document giving specific information on the subject.

1850. At Oporto, in July, 1850, the ship *Edward IV* arrived from Brazilian ports infected with yellow fever. Some of the custom-house officers, sent on board in the discharge of their duties, were attacked with the disease, and of 5 stricken, 3 died. The sanitary authorities, with a view to averting a panic, tried to prevent the truth being known, and for a time succeeded in concealing the facts. Fortunately the malady did not spread widely. The disease was confined to the localities in which the custom-house employees lived.

1851. In the year 1851, there arrived at Oporto, the ship *Tentadora*, coming from Rio de Janeiro. During the voyage, 5 of the crew had been attacked with yellow fever. Several of the custom-house employees who went aboard the ship at Oporto were taken sick and died of yellow fever. The ship *Edward IV*, which during the previous year had

brought yellow fever to Oporto, again arrived at that port, September 10, having had deaths aboard from yellow fever during the voyage. The vessel spent twelve days in quarantine. After being given pratique, 2 custom-house men posted aboard to guard the ship were attacked with the disease and promptly died. A little later, 3 laborers employed in removing the cargo from the hold, and several other persons who had been on the vessel, were taken ill with the same malady. The disease afterwards spread in the quarters known as Miragaia and Masarellos and altogether 17 persons died in consequence. At this point, there arrived from Brazil another vessel, the *Santa Cruz*. The same malady was repeated among the custom-house employees, the stevedores, and other persons who in one way or another had had direct relation with the infected ship. The popular alarm occasioned by these frequent appearances of fatal cases resulted in the appointment of a sanitary commission for the study of the matter and the recommendation of measures of betterment. Notwithstanding the vigorous means adopted to this end, cases continued to occur. The infection spread to 2 British vessels anchored down the wind from the pest ship *Santa Cruz*. The British vessels were supposed to be quite isolated from the *Santa Cruz*. Soon other cases appeared on 2 Portuguese vessels anchored to leeward of the British vessels. Several of the men of the Portuguese vessels died. The epidemic lasted a short time only, but there were 40 deaths.

1856. The third epidemic occurred in 1856. Early in July some vessels arrived from Brazil, where yellow fever prevailed. July 12 the first cases appeared, and, as before, the first persons affected were custom-house employees, stevedores, and those in contact with the suspicious vessels. Again a focus of infection was established in the Miragaia quarter. There were also cases of yellow fever among the soldiers of the municipal garrison, but a marked difference was noted, both in the intensity of the symptoms and in the issue of the disease between the cases falling ill on board ship and those resulting from contact with infected persons and things. The first cases were congregated in a special hospital, and of these, 16 out of 21 died. On the other hand, only 10 deaths took place among the 27 soldiers attacked. Energetic measures were taken by the authorities of the port. The pest-ridden vessels were isolated and carefully disinfected. Certain of the vessels, being evidently deemed infected beyond hope of cleansing, were sunk at sea. This epidemic began July 21 and ended October 2, 1856. A total of 120 cases and 63 deaths resulted from the outbreak.

Belem is a small town not far from Lisbon. It was the seat of the lazaretto during the epidemic at Oporto. An extension of the epidemic began by the death from yellow fever of the wife of a pharmacist at Belem. This case was followed by others at considerable intervals, and finally an epidemic established itself. The disease was mistaken for typhus fever by the local physicians, but the members of the royal

commission that investigated the pestilence found that at least some of the cases presented the undoubted characteristics of yellow fever. There was an epidemic of Asiatic cholera at Lisbon in 1855, and the disease had not entirely disappeared in 1856, though it had diminished and was already decreasing. At about the time of the disappearance of the cholera, some cases of fever appeared in Lisbon having the same symptoms and epidemic characteristics of the yellow fever at Belem.

1857. In the year 1857, Lisbon had a population of 200,000 inhabitants. Preceding the period of the yellow-fever outbreak of 1857 the public health had been excellent. The mortality rate was less than for the corresponding period of the previous year. A commission delegated to make a report of the epidemic could not determine to a certainty whether the disease was imported by sea or came from the infection of former epidemics in Portugal. In March, the steamship *Tamar* had lost 2 men from yellow fever on a voyage from Brazil to Portugal. The steamship only touched at Portuguese ports, leaving immediately for England. It appears that it was this steamer that carried yellow fever to Southampton, a circumstance that will be referred to under another head. The vessel returned to Lisbon in the month of September. Early in July, a steamer called the *Genora* arrived at Lisbon, bringing immigrants from Brazil. Many of these persons were so ill that all of them were sent at once to Belem to pass the period of quarantine in a lazaretto. In the beginning of July, a seaman from the *Algarve* fell ill in the house where he lodged, and shortly after 9 persons sickened of the same disease in the same house. The commission reported that it was impossible to state what was the outcome of the disease in these 10 cases, from which it may be inferred that they were spirited away in the interest of their neighbors. At Lisbon, immigrant baggage and effects were stored in dirty and badly ventilated places. They contained trunks with the miscellaneous effects and soiled clothes of immigrants, packages of rags, and sundry articles, many of them evidently filthy from human vomit, sputum, and feces. July 22, a person employed at the baggage division of the customs service was taken ill and died in five days with the symptoms of yellow fever. July 29, a woman who had been in frequent contact with the customs employees fell sick and was dead in five days. From this moment, cases began to multiply in the localities where the first cases were treated. Neighboring habitations were in turn invaded, and finally whole streets and quarters of the town became filled with cases. Ultimately, distant foci developed, originating evidently from persons in contact with yellow-fever patients.

While in the city the epidemic was assuming gigantic proportions, the health of the harbor remained perfectly good. No suspicious cases were reported on board of vessels anchored in the harbor, nor among the public servants stationed on or near the water, to guard the port and shipping. From these facts, the royal commission concluded that

the infection had been introduced, not by the vessels or their personnel, but by filthy fomites deposited in the customs magazines of the ports.

During this epidemic, 13,757 persons were ill with the disease, and 5,652 died. Of the 5,915 cases treated in hospital, 1,932 died. Of the 7,482 treated at their homes, 3,466 died. The other deaths evidently occurred among vagabonds and those who succumbed in public places not under medical control. The relative proportion of the cases to the inhabitants was 1 to 35.4; the proportion of cases of yellow fever to other diseases was 1 to 3.18. Of the 3,466 who died at their homes, 2,061 were males and 1,405 females. The mortality was much greater in proportion to the number affected among adults than among children. Most of the old persons who were stricken died. The commission noted that occupation had no influence in imparting the disease except in so far as it involved exposure in the open air during the night. The fastigium of the epidemic was reached during the month of October. At the beginning of the epidemic, the disease in individual cases ran its course in from fifteen hours to five days. Later in the epidemic the disease lasted longer in the fatal cases as well as in those that ended in recovery. In the hospitals, the greater number died during the first three days of the disease, and as the disease progressed there was a constantly diminishing mortality. The accessible hospital records give the following showing:

Discharged three days after admission.....	344
Discharged five days after admission.....	357
Discharged seven days after admission.....	762
Discharged eleven days after admission.....	788
Discharged fifteen days after admission.....	345

A few only remained in the hospital for a month or more. Of persons employed about the hospitals, one-sixth were taken sick with the disease and among these there was a mortality of 25 per cent. It was especially remarked that at the gas works, where illuminating gas was produced, not a single case of yellow fever occurred among the employees, although the trade exposed the workers to the night air. In this connection it is interesting to consider whether it might not be that illuminating gas or other products evolved in its manufacture served to kill mosquitoes, spoil their appetite for human blood, or at least keep them at a distance.

During the epidemic at Lisbon there were 112 cases of yellow fever in the neighboring city of Olivaes, which at the time had 23,000 inhabitants. Sixty of the sick persons were fugitives from Lisbon. In other neighboring places scattered cases developed. It was remarked that the quality and direction of the wind had no perceptible influence in the propagation of the disease. The epidemic commenced July 22 and was declared finished December 10, 1857.

1858. During the months of January, February, and March, 1858, cases of yellow fever were reported at intervals in Lisbon. In consequence, a total of 11 deaths were attributed to the disease.

1858. At Vigo, Fereol, Oporto, and at Ponta Delgada, in the Azores, cases of yellow fever were imported by vessels arriving from Brazil, in 1858. The sick persons were promptly isolated and the disease did not spread.

YELLOW FEVER INSTITUTE,

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, Surgeon-General.

BULLETIN No. 5.

Section A.—HISTORY AND STATISTICS.

Surg. GEORGE T. VAUGHAN, Chairman of Section.

YELLOW FEVER IN SPAIN.

By J. M. EAGER, *Passed Assistant Surgeon, M. H. S.*

MARCH, 1902.

YELLOW FEVER IN SPAIN.

In connection with the first appearance of yellow fever in Spain, the interesting question arises of the initial occurrence of yellow fever in Europe. According to Moreau de Jonnes, the primary importation into Spain was in 1705. If this were true, Spain could claim to be the first European country afflicted with the disease, for the story of the alleged outbreak at La Rochelle, France, in 1700, lacks scientific authority. Villalba, the famous Spanish epidemiologist, maintains, however, that the original introduction into Spain took place in 1730. In this opinion all the writers of importance who have succeeded Villalba thoroughly concur. So that, in the light of all available evidence, it must be considered that the initial advent of yellow fever in Europe was at Lisbon, Portugal, in 1723.

1730. In the year 1730 a ship from the Americas brought to Cadiz a malady never before seen in that city. The disease was characterized by a malignant fever, a yellow discoloration of the skin, and, in the last stages of fatal cases, by black vomit. Many persons were stricken with the malady, and the epidemic diffused itself through other cities of Spain.

1733. At Cadiz the disease was again imported in 1733, but the prevalence was not extensive.

1741. A vessel from the Antilles landed a large cargo of merchandise at Malaga. Immediately afterwards a pestilential malady was evolved,

a disease exhibiting the same aspects as the fever at Cadiz in 1730, and of such mortal violence that 10,000 persons died from the scourge.

1744. Cadiz was again afflicted with a visitation of yellow fever, brought into the country by vessels from the Antilles. The extension of the disease was of moderate intensity. The epidemic spread to Majorca, in the Balearic Isles.

1746. At Cadiz a vessel from Cuba again introduced yellow fever.

1749. Another importation took place at Majorca, but the effects were not of much importance.

1753. The squadron of Admiral Don Pedro de la Cerda brought yellow fever to Cadiz. The infection originated in America and was taken to Cartagena by the same ships of war. Happily there was not an extensive spread.

1800. The disastrous epidemic of this year commenced at Cadiz toward the latter days of July. Its first appearance was in the quarter known as Santa Maria and, by August 4, had counted many persons among its victims. The infection spread furiously in the quarters of Ave Maria and San Antonio. Day by day from August on, the pestilence extended, propagating itself through all the neighboring sections of the city. The origin of the contagion was attributed to three sources. Suspicion fell first on the American corvette *Dolphin*, which left Havana, May 27, 1800, for Charleston, where she arrived four days later. From Charleston, the vessel sailed, June 11, for Cadiz, at which port she arrived July 6, 3 of the crew having died of yellow fever on the voyage. Twenty days after the last death and on the completion of ten days of rigid isolation, the health of all aboard being perfect, it was decided to give the corvette free pratique. The second possible origin of the disease was the corvette *Aigle*, which sailed from Havana, May 22, 1800, and on the passage to San Lucar de Borameda lost 5 hands from yellow fever. At San Lucar de Borameda, the crew dispersed and other men were shipped. The *Aigle* arrived at Cadiz June 30, six days after the arrival of the *Dolphin*. A third suspicious source was the ship *Jupiter*, cleared from Vera Cruz, February 4, and arrived at Cadiz, March 28. A few days after her departure from Vera Cruz, 1 of the officers fell ill and died in five days. Then, one after another, all hands aboard were taken sick. The condition of the ship was at one time so desperate that the captain was undecided whether to proceed on the voyage or return to Havana. The members of the crew, however, made a good recovery from their illness, and the vessel went on her way. In addition to the 3 vessels that fell under direct suspicion, it is noted that, a large number of vessels were continually entering the port and that by an order of the King, dated February 1, 1800, it was absolutely prohibited to submit to quarantine any vessel coming from America. Thus all safeguards were for the time removed.

This epidemic was extremely desolating and mortal. Cadiz had at the time a population of 57,499. From August 18 to November 30, the

number of persons who had fallen ill of the disease was 48,520 and of these 7,387 died. At the latter date, there were 357 cases still under treatment. Of those who died, 5,810 were men and 1,577 women. So that of the fatal cases, between 78 and 79 per cent were males. The maximum mortality among males occurred between the ages of 21 and 40, and for females between the ages of 1 and 10 years. The sickness diffused itself in several communities, among others Puerto Santa Maria, Isla de Leon, Puerto Real, Xeres de la Frontera, and finally it reached Seville, August 23.

Seville then had a population of 80,568 inhabitants, of whom 76,685 were attacked by the malady, and 14,685 died. November 30, at the time the statistics were prepared, 85 cases were still ill. The disease appeared in Seville at practically the same time as at Cadiz, perhaps because the destination of the passengers of the corvette *Dolphin* was about equally divided between the two places. It should be remarked that the statistics gathered from a relation of the facts given by the celebrated Dr. Arejulas, who was detailed by the Spanish Government to investigate the disease, differ materially from those contained in a report sent to the Danish Government by Schousboe, consul of Denmark on duty at Cadiz. The two writers are in accord concerning the time and mode of introduction of the sickness, the way it extended and the clinical form it assumed, but differ essentially in statistical figures.

Arejulas' estimates are given in the following table :

Cities.	Popula- tion.	Deaths.	Cities.	Popula- tion.	Deaths.
Cadiz	68,000	16,000	San Lucar.....	18,000	4,000
Isla de Leon.....	32,000	6,000	Rota.....	6,000	1,500
Puerto Real.....	10,000	3,000	Xeres de la Frontera.....	30,000	8,000
Malana	10,000	(?)10,000	Seville.....	80,000	30,000
Santa Maria.....	25,000	6,000			

Therefore, in a population of 279,000 there were 77,500 deaths. The disease also invaded Cartagena, assuming grave features and making a shocking slaughter among the inhabitants.

1801. Yellow fever broke out August 3, 1801, in Medina-Sidonia. The first person attacked died in six days. A few days later the relatives of the dead man were stricken, then the malady manifested itself among the inhabitants of neighboring houses, and finally step by step the epidemic spread itself over the entire city.

1802. After the doleful visitation of 1741, yellow fever had spared the city of Malaga at times when it worked its ravages in other cities of southern Spain. But in 1802, Malaga suffered a small epidemic of brief duration.

1803. The slight prevalence of the previous year was like a mild premonition of the terrible calamity that tormented Malaga in 1803. The importation was blamed upon various vessels. A Dutch ship, the

Giovane Nicola, sailed from Smyrna, March 14, and arrived at Malaga on the twenty-second of the same month. During the voyage she had been obliged by contrary weather to take refuge in several ports. Suspicion attached to her. Two French ships were also considered questionable from a sanitary point of view. They were the *Desaix* and *L' Union*, carrying soldiers between Marseille and Santo Domingo and had had deaths of a doubtful nature aboard. The Spanish ship *Providencia* too was viewed askance by the sanitary authorities. She arrived June 9, from Montevideo with dirty documents, tales of yellow fever and, notwithstanding all this, had been submitted to only a brief period of detention. This much, however, is certainly known. The first case of yellow fever was verified in the person of Felix Muñoz, a smuggler, who had gone on board the Dutch ship and returned to Malaga with some pairs of cotton stockings and a quantity of tobacco. Shortly after he sickened of yellow fever and died in five or six days. The municipal sanitary authorities closed the house of the dead man and sent to the open country all those who had been in contact with the patient or who had stopped in the neighboring domiciles. Thirty-six days passed without any case manifesting itself. The disquieting apprehensions of the citizens were therefore calmed for the moment. However, one Christobal Verduras, living in the Perchel quarter, had during this time received another smuggler in his house, where the man was taken ill and died promptly. The facts were for the time concealed and the cadaver transported secretly from the house in the night and buried in the church of San Pedro. August 6, the son of Verduras fell sick, and then his wife and then 3 other sons. In short, within eight days after the death of the second smuggler, 8 persons of Venduras' family were prostrated in the same manner. Three of them died. Afterwards there were cases in the habitations surrounding that of Verduras. At the same time, another center of infection was established where the first smuggler was buried. The parish priest, the pallbearers, the sacristan were attacked, and likewise the physicians who had treated the patient. All of them died. In this way making gradual advances, the whole city was invaded by an intensely pernicious contagion. The epidemic endured until December 18. Of the 48,015 inhabitants that Malaga numbered at the beginning of the outbreak, many fled from the city and carried the scourge throughout southern Spain. The noxious character of the disease is evident from the figures which show that of those who remained in Malaga, 16,517 fell ill and 9,333 died. On December 18 there were still 300 persons convalescent in the hospitals. A fact worthy of remark is the absolute immunity of the large prison in the center of the infection. In the beginning of the pestilence, the commandant of the prison established rigorous isolation and thus seems to have saved those detained in his custody. In the same year, 1803, yellow fever spread widely in the city of Cadiz with great havoc to health and life.

1804. Being unable to fix upon a new source of importation, Spanish epidemiologists concur in the opinion that the renewed prevalence in 1804 was a recrudescence of the scourge of the preceding year. The second attack was for Malaga, at least, more disastrous than the primary invasion. When the first persons were affected in the latter part of June, a wild panic ensued. The inhabitants fled in swarms, so that on July 1 only the poor and needy remained. It appears, however, from the chronicles of the day that this class was sufficiently numerous to furnish ample fuel for the epidemic. It is recorded that, before the close of November, there had been at Malaga 18,582 cases of yellow fever and 7,726 deaths.

Gibraltar, owing probably to the severe measures insisted upon by the local government, had in past years remained free from yellow fever. Presuming upon this fortunate immunity, there was in 1804, from all accounts, a decided relaxation of vigilance. Through the rents in the cordon, several smugglers from Cadiz or Malaga stole into Gibraltar. That they carried something more harmful to public interests than contraband goods is obvious from the sequel. Some of them developed yellow fever in the midst of the healthy population of Gibraltar and died diffusing the contagion among the inhabitants. The epidemic was very deadly, causing a mortality of 4,000 souls.

Cadiz suffered with the other Spanish cities in this year of gloom. The epidemic disease, imported evidently from Malaga, showed a most malignant violence.

Alicante was also fiercely tormented with yellow fever.

At the time of the outbreak at Malaga, a tailor named Delgado, who lived in a house in the Strada Puerta Nueva, escaped from detention and arrived at Antequara July 23. Four days later he was prostrated with yellow fever and died on the sixth day. His father and mother, 3 brothers and 2 sisters lived in the same house. Of these 7 persons, 5 speedily succumbed to the disease. The contagion then spread with incredible swiftness and swept down before it such a number of people that there was not time enough to bury the dead. In the early days of October, the violence was so mortal that between 30 and 37 persons died every day. The populace with religious fervor, hoped, by rendering thanks to God for the preservation of the living, to abate the affliction. A procession was formed with lavish sacramental accompaniments. The ceremony lasted for several hours and was participated in by persons of all classes. The hope of the people seemed, however, to be vain. An augmentation of the epidemic immediately set in and the daily register of deaths ran up to between 80 and 85. November 6 the epidemic was declared ended.

An interesting incident is related as accounting for the outbreak of yellow fever at La Rambla, the same year. A man from La Rambla, moved by religious ardor, was seized with a desire to touch the litter on which the body of a man dead of yellow fever was being borne to the

grave. Returning to his native place, the citizen of La Rambla began to ail from a slight febrile disorder, but was well in a few days. A cousin who had waited on the sick man died of yellow fever a week after. A little later, several other persons who had been in contact with the fever patient fell ill also. Thus several foci of contagion originated at La Rambla, where the disease continued its destruction until November 15.

The epidemic at Mantilla in 1804 was attributed to a monk from Malaga who was taken sick at Mantilla, August 11, and died in five days. The houses where the deaths had occurred were closed and all persons having contact with the cases were isolated. September 4, another monk, a fugitive from Malaga, was attacked with yellow fever and in a few days died. A muleteer returning from Malaga fell victim to the same fate. From these foci, the disease extended to a large portion of the community, but owing, it appears, to the energy of the sanitary authorities did not work such ruin as elsewhere. November 29, the city was declared free from yellow fever.

The city of Espejo is located on a very high level. There arrived, August 27, a muleteer carrying merchandise bought at Malaga. The man fell sick promptly and the physicians diagnosed the case as one of yellow fever. The patient was at once carried into the open country and the goods he had brought were destroyed. All persons who had contact with the muleteer sickened and a majority succumbed. The disease extended at first to the portion of the city frequented by the friends of the muleteer. A rigorous cordon was instituted and thus other sections were spared. The disease terminated November 25.

The prevalent disease was introduced into Vera by a family flying from the rage of the epidemic at Cartagena. Almost all the members of the fugitive family were stricken and died. October 3, an assistant at the hospital was attacked and died the tenth day. From that time on, the malady prevailed in the infected quarter, ceasing in the last days of November, but complete isolation saved the rest of the city.

Ronda, another Spanish city suffered from the scourge of 1804. Two men flying from Malaga took lodgings at Ronda, in the house of a woman of easy morals. The woman died August 4, after an illness of a week's duration. August 12, a neighbor was taken sick and died in two days with the symptoms of yellow fever. All the houses in the neighborhood were then quarantined. This wise police system operated to end the epidemic by the end of October, but not until 50 persons had died of yellow fever.

So far it has been seen that, after nearly half a century of immunity, Spain suffered 5 annual recurrences of yellow fever ending in the year 1804. Then followed a period of freedom from the disease lasting until 1808.

1808. In this year an importation of yellow fever took place at Cadiz, but the developments were unimportant.

The consequences were less happy, however, at Xeres de la Frontera, in which city an individual from Cadiz diffused the contagion. Rigorous prophylactic measures were taken to protect the large prison at Xeres de la Frontera, and were successful until near the decline of the epidemic. At that point some prisoners slipped away, but were captured and returned to the prison. They brought back yellow fever with them, and so terrible was its effects within the prison walls that only a few of the convicts escaped death.

1810. In August of this year an epidemic appeared simultaneously in Gibraltar, Cadiz, and Seville. It was impossible to determine definitely where the disease began, but it seemed probable that it was introduced into Cadiz and Seville by smugglers. Its maximum prevalence was at Gibraltar. The epidemic was also transplanted in Cartagena and attained considerable violence.

1811, 1812. At Cartagena, the disease appeared again in the 2 following years and, inasmuch as no new source of importation could be discovered, the epidemics of 1811 and 1812 were considered to be a reawakening of the pestilence of 1810.

1813, 1814. In these years there was yellow fever at Gibraltar, the first year from an original importation, the following year from a revival of the contagion introduced the previous summer.

1819. Spain had enjoyed five years' exemption from yellow fever when a period of deadly pestilence arrived. Cadiz was doomed to suffer one of the most widespread and mortal epidemics that ever fell to her fate. The King of Spain prepared a military expedition to go to the Americas and, among other vessels, hired a ship named *San Juliano*, recently returned from the Philippine Islands. The vessel had scarcely begun to take her cargo of cannon powder at the Isla de Leon when suspected cases of yellow fever appeared among the persons employed aboard. The disease broke out also in the quarter of the city called Barrio del Christo where the baggage of the crew of the *San Juliano* was deposited. The persons taken sick all died and very quickly too. This occasioned great alarm in Cadiz and the commandant of the city sent his chief sanitary officer, Dr. Flores, to Isla de Leon to study the disease and report on its nature. Dr. Flores, convinced from his investigations that the disease was yellow fever, declared that rigorous measures alone could avert a disaster. But his counsels were not listened to. On the contrary, he was accused of high treason and held for trial before a tribunal of war. The commanding general assured the alarmed population that yellow fever did not exist on the Isla de Leon, and boastingly added the rather unintelligible information, that should it enter the city of Cadiz, he was prepared to meet it with the point of his sword. Notwithstanding all assurances to the contrary, the unheeded warning of the unfortunate Flores came true. The scourge struck with frightful force, and among the first to run away from the city was the redoubtable general.

From July to December, when the epidemic ended, there were 40,000 cases and 8,000 deaths in Cadiz.

A woman who fled from Cadiz took refuge in Seville and died there from yellow fever. From this focus the disease extended throughout the city, manifesting the same violence and malignancy that it had shown at Cadiz.

The epidemic also entered Xeres de la Frontera, where it was highly mortal in its effects.

1821. The story of the fatal diffusion of yellow fever at Barcelona in 1821 is one of the most dismal in the sanitary history of Spain. In the port were anchored many vessels of all nations, among them the *Tailla Piedra* and the *Gran Turco*, recently arrived from Havana. A great festival was arranged for July 12, to celebrate the anniversary of the promulgation of constitutional law in Spain. Bad weather prevented the feast being celebrated in the harbor, and the festivities were therefore postponed until July 15, the following Sunday. On Sunday the weather was splendid and a large concourse of people congregated to witness the fine spectacle. Captain Sagredas, commanding the *Gran Turco*, gave a reception on board his ship. His wife, their children, and many other persons, altogether 40, attended. Later, the whole party paid a visit to the *Tailla Piedra*. After spending a couple of days aboard the *Gran Turco*, the captain's family went to Barcello. netta, where they lived. In a few days every member of the family sickened of a strange malady, and all died. A like fate befell most of the other persons who visited the *Tailla Piedra*. Of the 40 persons, 35 died.

Near these ships, the French brig *Josephine* was riding at anchor. The crew was taken with yellow fever and few survived. There were suspicious cases, too, on board a war ship of the Kingdom of Naples. They were at first attributed to food poisoning from using for culinary purposes a badly tinned copper vessel. The captain of the *Josephine* took lodgings ashore at Barcelona. Eight days afterwards, the woman who kept the inn, where he stopped, was attacked by yellow fever, and in rapid succession her husband, their children, and the servants fell ill. The disease reached out into the neighborhood, extending in a short time to the whole quarter, and later overspread the city of Barcelona. The municipal authorities adopted proper sanitary measures at the outset, but they met with great opposition from the people who objected to interference with their business and pleasure, and foolishly refused to regard the situation seriously until the epidemic had gained the upper hand. The maximum intensity of the prevalence was in September. The Report of the National Academy of Barcelona, says:

It is impossible to know positively the number of victims carried off by the epidemic that covered Catalonia with mourning, nor to state the number of those that died in the neighboring country or that gave up their lives at Mahon, Tortosa, and Mequinenza.

Francois (in his report to the French Government), Mazet, Pariset, Bally, and Auduard agree in estimating that approximately in the city of

Barcelona, during the five months that the epidemic raged, 25,000 persons died. Of the population of 150,000, about 80,000 fled from the city.

The same year, 1821, a Danish brig, the *Initium*, sailed from Barcelona and in six days reached Malaga. On the voyage 4 of the seamen were sick with yellow fever, and 1 died at sea. Arriving, the brig was committed to the lazaretto. After a period in quarantine, she was given free pratique and took two additional hands aboard. These new men promptly sickened of yellow fever, and both of them died. Suspicious cases appeared on some English, Danish, and Dutch vessels that were anchored alongside the *Initium*. At the beginning, the sickness was confined to the vessels in the harbor, but early in September a master calker, who had been working on one of the ships, carried home with him some effects that had been aboard. September 7, his son was taken ill and died. Then he himself fell sick, but recovered. Other cases broke out on the same street; other quarters became infected, and so the disease diffused itself over the city.

The city of Tortosa had never suffered from an invasion of yellow fever, even at times when the disease was most widespread in Spain. In the night of August 5, the ship *Madona de la Cinta*, coming from Barcelona, entered the port of Tortosa and set ashore a seaman and a soap maker. Both of them died shortly of yellow fever. The seaman died in the country and the soap maker at the house of a soap manufacturer. The latter and his family were stricken with the disease. Then the doctor and the priest fell ill. In this manner the disease invaded the city. The form of infection from all reports was extremely fatal, for it is recorded that all the physicians, pharmacists, priests, monks, and nuns in the city died.* After a month's time only 5,000 persons remained in Tortosa. Ten thousand persons fled, and at the end of the epidemic 4,500 of the 5,000 that remained were dead of yellow fever.

Also, a city situated on an elevated site about 30 kilometers from Tortosa, was taken with yellow fever and almost decimated. A citizen of Tortosa while in Also learned that his wife was ill in Tortosa. He borrowed a horse from a friend and hastened to join his wife. Both man and wife died. The owner of the horse wanted his animal back, so he sent a servant to Tortosa to fetch it. The servant brought back the horse, but died of yellow fever and infected Also.

Meguinenza also suffered an importation of the pestilence through the medium of a vessel from Tortosa which arrived August 28. A sailor was taken ill soon after disembarking and died August 30. Other members of the family died in a few days, and finally the malady affected a large portion of the community, producing disastrous results.

Palma, the capital of the Balearic Isles, paid tribute also to yellow fever in 1821. A vessel bound from Barcelona to Majorca carried on board a merchant of Palma as a passenger. Arriving home the merchant was attacked with yellow fever, but recovered. Two days later, his little daughter was taken ill and died. From this focus, the disease

was disseminated, attaining the proportions of a great epidemic that destroyed half the population of Palma.

The frightful fierceness of the epidemic of 1821 in Spain, and the havoc produced in the wealth and life of the richest industrial section of the peninsula by frequently repeated and devastating pestilences, attracted the attention of other nations. There were accusations of negligence in the enforcement of sanitary regulations. This led the Government of Spain to adopt precautions for the prevention of future disasters. The leading academies and societies of medicine in the Kingdom were interpellated as to whether yellow fever could be considered absolutely of American origin and of an infectious and contagious nature. With several opinions to the contrary, the majority were convinced of the exotic origin of the disease and that it was infectious and contagious. As a consequence, stringent provisions of maritime sanitation were devised and put into effect.

1823. In this year the little port of El Passaje, situated on the north coast of Spain, was infected with yellow fever by the Spanish brig *Donastierra*, from Havana. The authorities sank the infected ship. There were only a few cases ashore.

1829. Two ships, the *Dydden* and the *Neta*, arrived at Gibraltar, having yellow fever aboard. Linen soiled with vomited matter was sent, part to a laundry in Gibraltar, part to a laundry in the village of Catalan Bay. The washerwomen contracted yellow fever and died. The infection was circumscribed and not very violent.

1870. After over forty years' immunity, Spain again found yellow fever within her borders. Early in August, 1870, the ship *Maria* arrived at Barcelona from Havana having yellow fever aboard. Through some irregularity, it is stated, the vessel was given free pratique without being required to undergo the necessary sanitary treatment. The physician of the port and the secretary of the sanitary office were blamed for the importation. They were both taken with the yellow fever and died. Other members of the same families were stricken and then some persons who had been in direct contact with the sick and with their effects. The disease spread through the city. During the months of August and September the mortality reached its maximum. Toward the middle of October the daily mortality varied from 25 to 40.

The disease extended rapidly to Valencia, Alicante, and Palma and was taken by refugees to Madrid. There were only a few cases in the capital.

1878. The history of yellow fever in Spain ends with an epidemic at Madrid in 1878. A body of soldiers from Havana was disembarked at Santander and transported by rail to the capital city. They had scarcely arrived in barracks when yellow fever broke out attacking 50 soldiers, of whom 30 died. All the soldiers who fell sick had come with the party from Havana. The disease was not communicated to the other persons who were in attendance on the sick.

YELLOW FEVER INSTITUTE,

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, Surgeon-General.

BULLETIN No. 6.

Section C.—TRANSMISSION.

Surg. J. H. WHITE, Chairman of Section.

A NOTE ON MOSQUITOES IN BAGGAGE.

By S. B. GRUBBS, *Assistant Surgeon, M. H. S.*

(Experimental Investigation in Hygienic Laboratory, M. H. S.)

MARCH, 1902.

A NOTE ON MOSQUITOES IN BAGGAGE.

In the light of recent well-known work, showing that the infection of yellow fever may be transmitted by certain mosquitoes biting a person suffering from that disease, and, after a certain lapse of time stinging a nonimmune person, and on account of the modifications in the methods of preventing the spread of this disease proposed on account of this discovery, enormous sanitary and quarantine interest attaches to the question, How far may a mosquito be carried in baggage?

That these insects may be harbored for weeks in vessels and railroad trains, and even breed in enormous quantities in the water tanks of ships, and so be carried almost any distance, has been shown in many instances. Howard considers the railroad one of the principal means of spreading this pest, and instances are numerous of out-of-the-way villages or localities, previously free, being infested with mosquitoes after getting railroad connections (*a*).

Interesting instances of mosquitoes being carried great distances at sea were reported lately in the public health reports. Passed Assistant Surgeon Cumming stated that the Spanish bark *Maria Blanquer*, sixty-five days from Rio de Janeiro, arrived at South Atlantic Quarantine Station carrying a veritable plague of mosquitoes, most all of which were the

(*a*) Howard, "Notes on the mosquitoes of the United States," and one instance personally known to the writer.

Stegomyia fasciata. Even admitting the captain's statement that there were none aboard before the twenty-second day, this leaves forty-three days that the insects were transported in the winged form. In the water tanks of this vessel great quantities of larvæ were found showing that the mosquitoes were propagating on shipboard as prolifically as they do on land. If a vessel can carry the *Stegomyia fasciata* on a voyage of sixty-five days during all of which time they propagate and multiply, it is evident, that within certain climates, they could so continue on a voyage of any length, thereby bringing these pests to our ports from foreign shores.

Surgeon Havard, of the Army, in a letter to the Medical Record cites the experience of Dr. L. S. Harvey, U. S. A., who reported that he accidentally carried mosquitoes in his chest from Baracoa, Cuba to Washington. The chest was closed sixteen or seventeen days, and yet the mosquitoes were able to fly away and escape when it was opened here. In commenting on this interesting observation Colonel Havard says:

If, while a trunk is being packed, and left open for that purpose, mosquitoes alight in it, it is not unlikely that they may become caught among the folds or layers of clothing and I doubt very much whether the usual amount of pressure put upon the contents of the trunk when closing it will destroy those which have found refuge in the many spaces existing in the corners, inside the trays, or between garments.

Assuming it to be perfectly possible for mosquitoes to enter a trunk or other piece of baggage, even when carefully packed, it has been the aim in a series of tests to see how long the insects could so live. The experiments were made on the *Culex pungens*, whose degree of comparative resistance with the *Stegomyia fasciata* has not been determined, but it is reasonable to suppose that the two varieties are not greatly dissimilar in this regard. We have especially desired to determine how long mosquitoes would live packed in different places in trunks more or less full of clothing and ordinary travelers' articles and under various conditions of moisture and temperature and with the presence of aromatic substances sometimes present. To this end mosquitoes were packed in trunks in different ways, and, besides, these conditions were imitated by wrapping the insects in towels, as then they could be placed in a temperature of 37° C. (incubator), of 25° to 28° C. (ordinary August heat), of 19° to 20° C. (cold room), and of 10° to 13° C. (ice chest).

In general it was found that this mosquito (*Culex pungens*) lives but a short time in close confinement and that the greatest factor in prolonging its life is moisture. The next factor of importance is a certain amount of cold, the most favorable temperature appearing to be about 20° C. As it is the female that attacks man it is also interesting to note that she regularly survived the male under nearly all conditions, as would be expected by natural laws.

Mosquitoes left exposed in a pill box, one side of which was covered with gauze, if dry and unprotected, usually die over night; if protected

by a damp cloth they may live twelve days provided the temperature does not exceed 20° C. If loosely packed in a trunk at summer temperature (23° to 28° C.) among clothes that are very slightly damp, they will nearly always live six to eight days, and then they most often come to grief from some outside influence, such as getting stuck in moistened glue of the box, or by being entangled in the growth of a mold. If dry, but protected by cloths or by being packed among clothes their average life is two days.

The results in many experiments have varied considerably, but the following may be cited as an average series :

Treatment.	Result.
In large dry towel 37° C. In large damp towel 37° C.	All dead first day, Lived until fifth day. Probably affected by growth of mold.
In large dry towel 27° C. In large damp towel 27° C.	Died between the first and second day. Died between fifth and sixth day, at which time towel dry.
In large dry towel 20° C. In large damp towel 20° C.	Died between third and fourth day. Five out of six died between the eighth and ninth day. One female lived twelve days.
In large dry towel 11° C. In large damp towel 11° C.	Died between fourth and fifth day. All lived until eighth day. One female lived until eleventh day, then probably crushed.
Tightly packed in clothing of trunk, perfectly dry. Temperature 23° to 28° C. Same as above, except clothing damp.	Died between second and third day, All alive on seventh day, found crushed from tight packing on the eighth day.
Placed under loose clothing in trunk, dry, 23° to 28° C. Same except clothing damp.	Died between third and fourth day. Died between ninth and tenth day.

As the glue in the paper boxes so often became softened, entangling the mosquitoes, tin ointment boxes with the top replaced by gauze were tried, but the water of condensation proved a great objection, as can be seen.

Treatment.	Result.
Wrapped in two damp towels, kept at 37° C., 5 males and 6 females.	Three were alive on third day, rest being in water of condensation that covered the tin. All dead fourth day, same cause.
Wrapped in two damp towels, kept at 20° to 25° C., 11 females.	Inspected on third day. All drowned in water of condensation.
Wrapped in two damp towels, kept at 20° C., 10 females.	All dead between eleventh and twelfth day.
Wrapped in two damp towels, kept at about 11° C., 4 males and 5 females.	All dead by sixth day except 1 female which remained alive and apparently strong until between the twelfth and thirteenth day.

Mosquitoes packed in ordinary trunks containing moth balls (naphthalin) or camphor, as they are used to keep away moths, but otherwise under the most favorable conditions of protection and moisture, always died in from twenty-four to forty-eight hours. The presence of tobacco, however, seems to have little effect.

Fearing lest the daily inspection of the boxes once packed away might tend to lengthen the insects' live by the renewal of the air about them, one series was made packed in damp cloths, in which one box was inspected each day or two and not again packed. Most of these

were ruined by the growth of molds, but boxes were found having one or more alive on the second, fifth, seventh, and eighth days.

By the word damp it must not be understood that a factor of moisture was introduced greater than could be found in actual packed clothing. In most of the experiments and in all of those cited, the wet towel or piece of fabric to be wrapped about the box was wrung out by hand as much as possible and then folded in a dry towel and the wringing repeated. This would leave it a little damper than freshly ironed linen, or the filthy sweaty clothing so often found by those engaged in practical disinfection.

As before stated, all these experiments were made on mosquitoes confined in circular pill boxes, one side of which had been replaced by gauze. Their arrangement prevented their being crushed in the packing and manipulations, but also introduced two features that would tend to shorten their lives, viz. first, the violence done in getting them into a small box, and, second, the restraint that prevented them from themselves seeking the conditions best favoring their survival. This ability of the mosquito to protect itself is very pronounced and has been noticed in the experiments made on them with gaseous disinfectants. (Laboratory Bulletin No. 6.) It would probably play a rôle in prolonging its life under natural conditions.

Disregarding these unnatural conditions, we must conclude from our observations on the *Culex pungens* that mosquitoes having once found their way into trunks, boxes, bundles, or other baggage could live there at least five days, ample time to carry them from the infected ports of Mexico or Cuba to any of our Southern ports. It is true the vast majority of the *Stegomyia fasciata* so carried would probably not be infected, but even these could by their propagation render infectible a locality previously immune.

Some eminent authorities, speaking from a practical standpoint, have opposed this view. Reed, of the United States Army Commission, in an address on "The Prevention of Yellow Fever," read at the twenty-ninth annual meeting of the American Public Health Association at Buffalo, said:

The fear that has been entertained that infected insects may be imported in boxes or trunks we believe to be absolutely groundless, and this for the simple reason, as shown by numerous observations made by us, that mosquitoes, when deprived of water, die within a few days. Even if allowed to fill themselves with blood immediately before the experiment is begun and then deprived of water, practically all are dead by the expiration of the fifth or commencement of the sixth day. We may say that of a large number of insects tried in this way only 1 female has survived until the sixth day, and then in a feeble condition. Males and females which have been living on sugar and water, or fed two days before on blood, if deprived of water and food, begin to die after twenty-four hours, and all are dead on the fourth morning. Free access to water, therefore, is necessary for the existence of this mosquito.

As will be seen the above view is in accord with our observation that mosquitoes kept exposed to ordinary conditions or in dry wrappings

die in two or three days. However, this does not consider the factor of moisture except as water. The effect that a very slight amount of moisture will have on the length of time this insect will live is really remarkable. A mosquito that has entered a piece of baggage would never have free access to water, but it could often find the small amount of moisture necessary for its existence, and it could besides find protection from atmospheric conditions, for, as we have remarked, our confined mosquitoes live longer if wrapped even in a perfectly dry cloth than when entirely exposed.

Surg. H. R. Carter, of the Marine-Hospital Service, whose painstaking and extensive observations are well known, writes :

For the twenty years preceding 1899 the baggage from Vera Cruz, Havana, and Santiago de Cuba, on vessels arriving at New York, unless with yellow fever en route, entered without disinfection. The amount of this baggage from Havana and Vera Cruz is large, and it is not possible but that much of it came from houses infected with yellow fever and much of it was not clean. All of this baggage was opened at the custom-house at New York and handled in hotels there and at Saratoga, and no yellow fever is reported among the customs inspectors in New York, or at the hotels during this time.

The baggage going from the same ports to Spain for the last thirty years is even more to be considered. Its amount has been enormous ; much of it (from the class of people to whom it belongs) must have been foul. Some, the lesser part, it is true, of this traffic goes to the Mediterranean ports of Spain—Valencia, Malaga, and Barcelona, etc.—which at times, 1870 and before, have been “infectible places,” yet, I think, we have had no yellow fever reported in the Peninsula since the epidemic of 1870.

Of course, negative evidence is convincing only in proportion to its mass, and that a piece of baggage or 100 pieces of baggage from an infected place did not convey infection to nonimmunes exposed to it, means little, yet the amount of this baggage is so large—I can not estimate it at less than that of 300,000 persons from Havana alone—that we must claim that a very large number of pieces of baggage from infected houses have been introduced into New York and Spanish towns, that numbers of susceptible people have thus been exposed under various conditions, but have not contracted yellow fever.

To me the mass of this evidence is sufficient to be convincing, and I count it proven that baggage from Havana and Vera Cruz will not convey yellow fever directly to people after the voyage to New York or Spain, thus that yellow fever is not conveyed by mosquitoes carried in such baggage.

Whether this time element is necessary, of course, is not determined by these observations, but it is a factor in them.

Whether the rare cases of yellow fever we sometimes see contracted from infection aboard ship may be due to infected mosquitoes brought aboard in the hand baggage of passengers, and opened soon after coming aboard, may be a question. The sister who developed yellow fever aboard the *Vigilancia*, en route from New York to Havana, is a case in point, and we occasionally see members of the crew with yellow fever. One occurred in Havana harbor on a Ward liner en route from Vera Cruz to New York in 1900. Other explanations of these cases may, of course, be possible.

It is equally true that yellow fever has frequently been conveyed by ships on which no yellow fever exists, and not unfrequently by vessels on which we can get no history of there having been any yellow fever. In these cases there are doubtless mosquitoes already infected in the hold or other parts of the vessel, to which the crew have not been exposed since they became capable of transmitting the disease ; or the crew may have been immune to the disease.

Thus looking fairly at both sides of the question and reviewing the experiments and observations that have been presented, it would seem that it is entirely possible for a mosquito to enter ordinary baggage and live there long enough to be carried from the infected ports within a few days sail of our Southern shores, but that in reality they are seldom so carried. Further observation by our quarantine officers and others alive to the subject is needed before final judgment is passed, and the object of this note is to stimulate such work on this important subject.

YELLOW FEVER INSTITUTE,

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, Surgeon-General.

BULLETIN No. 7.

Section D.—QUARANTINE AND TREATMENT.

Surg. R. M. WOODWARD, Chairman of Section.

YELLOW FEVER—ITS OCCURRENCE AND QUARANTINE MANAGEMENT AT THE PORT OF MARSEILLE, FRANCE.

FROM REPORT OF THE CONSUL-GENERAL OF THE UNITED STATES AT MARSEILLE,
FRANCE, TO THE DEPARTMENT OF STATE.

MARCH, 1902.

CONSULATE-GENERAL OF THE UNITED STATES,

Marseille, France, January 2, 1902.

SIR: I have the honor to inclose, for transmission to the United States Marine-Hospital Service, a report on the subject of yellow fever at Marseille, as instructed by the Department's circular of December 5, 1901.

I am, etc.,

ROBERT P. SKINNER,
Consul-General.

Hon. DAVID J. HILL,
Assistant Secretary of State.

YELLOW FEVER AT MARSEILLE.

Very little information is obtainable at Marseille concerning the subjects mentioned in the Department's circular of December 5. Thus far, France has escaped any serious epidemic from this cause. In 1821, Barcelona passed through a rather severe experience, and in 1857 Nantes was similarly afflicted, although but 7 deaths were reported at that time. In both instances, the disease was imported. The city of Marseille, properly speaking, has been absolutely exempt from cases of yellow fever, although on the quarantine island of Frioul it is not entirely unknown. The attitude of the Government with respect to this malady is fully set forth in article 61 of the quarantine law.

In France, from November 1 to February 20, if a ship arrives from a port contaminated with yellow fever, whether said ship be above suspicion, suspected, or infected, the authorities will limit themselves to a medical visit among all the passengers, the disinfection of all soiled linen and similar apparel, and bed clothing, and other suspected articles contained in passengers' baggage, and the disinfection of the ship or of the part

of the ship which the sanitary authorities may judge to be contaminated. If cases of yellow fever are found on board said ships, they will be immediately removed and isolated until their cure; the other passengers and the crew will be subjected to surveillance (as ordered by article 57), for seven days.

The happy exemption of this country from yellow fever causes the authorities to feel that there is practically no danger of serious epidemic from this source. Dr. Catelan, the chief of the quarantine, has long since been convinced of the danger of infection from mosquitoes, and his first care, so he tells me, upon the landing of cases at the island of Frioul, is to arrange mosquito nettings about the bed of the patient in such manner as to prevent the local mosquitoes from spreading the germs. I append herewith a list of the ships arriving with cases of yellow fever on board during the last ten years and other statistical information in relation thereto.

While the French Government is undisturbed with respect to the possibilities of yellow fever in this country, the ravages wrought by the disease in Senegal and other of the French colonies have awakened the medical authorities to the importance of the subject, and a commission of scientific men has recently been sent out from Paris on a mission of investigation. They have already visited Senegal, and are supposed to be en route for Brazil at this time. For many years the annual epidemics in Senegal were supposed to arise from unpreventable causes, and true yellow fever was not identified as such until comparatively recent times. The ravages are so severe in that colony that upon the outbreak of fever immediate efforts are made to deport all Europeans engaged there in business or in the Government offices. This radical action necessarily disturbs business, and the medical authorities are hopeful of finding some means of counteracting the plague.

ROBERT P. SKINNER,
Consul-General.

List of ships arrived at Frioul, infected with yellow fever, from 1891 to 1901.

Date.	Name of ship.	Nationality.	Port of departure.	Duration of passengers' isolation.	Number of passengers disembarked.	Cases and deaths during voyage.		Number in lazaret.	
						Cases.	Deaths.	Cases.	Deaths.
				<i>Days.</i>					
May 17, 1891	Béarn.....	French...	Plata.....	10	665	0	5	5	a 1
Jan. 19, 1892	Chérifon	do.....	Santos.....	3	103	0	2	0	0
Apr. 14, 1894	Espagne	do.....	Buenos Ayres and Rio Bahia.	4	336	2	1	0	0
Apr. 17, 1898	Provence	do.....	Brazil	5	416	8	4	0	0
May 3, 1898	Les Andes	do.....	do.....	.....	.....	2	1	0	b 0
May 11, 1898	Colombo	Italian.....	do.....	.....	.....	0	2	0	c 0
Nov. 3, 1899	Aquitaine ...	French...	Buenos Ayres.	3	.....	1	1	1	d 0
Aug. 18, 1900	Vauban.....	do.....	Rufisque...	7	5	3	2	0	0
Total.....	.....	.....	.....	.....	.....	.....	.....	6	1

a Four cured.

b Passengers remained on board.

c Left port same day for Genoa.

d Women entered at Frioul hospital on eighth day, had lost 2 children during voyage.



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Treasury Department, U. S. Marine-Hospital Service.

WALTER WYMAN, *Surgeon-General.*

YELLOW FEVER

IN

France, Italy, Great Britain, and Austria

AND

BIBLIOGRAPHY OF YELLOW FEVER IN EUROPE.

MAY, 1902.

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YELLOW FEVER INSTITUTE.

Treasury Department, U. S. Marine-Hospital Service,

WALTER WYMAN, Surgeon-General.

BULLETIN No. 8.

Section A.—HISTORY AND STATISTICS.

Surg. GEORGE T. VAUGHAN, Chairman of Section.

YELLOW FEVER IN FRANCE, ITALY, GREAT BRITAIN, AND AUSTRIA, AND BIBLIOGRAPHY OF YELLOW FEVER IN EUROPE.

By J. M. EAGER, *Passed Assistant Surgeon, M. H. S.*

MAY, 1902.

YELLOW FEVER IN FRANCE.

In a history by Arcere of the city of La Rochelle, published in 1756 (vol. 2, chap. 4, cited by Frank), there is a reference to an importation of yellow fever that occurred at La Rochelle toward the middle of the year 1700. The report, however, lacks proper corroboration.

1802. In the autumn of 1802, there arrived in the roads at Brest a squadron of 5 vessels of the line commanded by Admiral Villaret de Joyeuse. The ships had come from Santo Domingo. Among the crews were 42 persons in the active stages of yellow fever and many convalescents. The sick seamen were disembarked at the lazaretto of Tiberon, where 32 died. A custom-house official, after being for several days on duty aboard one of the vessels, the *Tourville*, was taken with yellow fever. He died at his home ashore. Fortunately, some of the medical practitioners who were called in to see the sick man had been in the West Indies. Thus the case was recognized as one of yellow fever. Strict sanitary measures were adopted and, probably owing to these precautions and the fact that the season was advanced, the disease did not spread.

The American ship *Columbia* arrived at Marseille in 1802 with yellow fever aboard, but there was no diffusion ashore.

1821. In this year there was an epidemic of yellow fever in Spain. Several vessels that had had yellow fever aboard on the passage from Barcelona entered the port of Marseille. All were remanded to the lazaretto. A carpenter who worked at the lazaretto died in a hospital at Marseille. Another case occurred in a hospital at Marseille that year in the person of a sailor who had come from Barcelona by land. The disease did not spread. The mayor of the city, with a view to averting an epidemic, sent for the famous professor Palloni, who had been through the yellow-fever epidemic at Leghorn in 1804, and whose diagnosis and advice were relied and acted upon at Marseille with the happy results mentioned.

1839. The corvette *Caravane* arrived at Brest with yellow fever aboard. During the voyage 116 members of the crew had been down with yellow fever and 33 died. No cases occurred ashore.

1861. In the year 1861 there occurred at Saint Nazaire the only important epidemic of yellow fever that ever broke out in France. In an article on mosquitoes and yellow fever, published in Paris last year (1901), De Gouvea concludes that the epidemic at Saint Nazaire, so carefully observed and recorded by Melier, was determined by mosquitoes infected at Havana and transplanted to France in the hold of a vessel.

The *Anne-Marie*, a ship of the port of Nantes, with a crew of 16 souls, sailed from Havana June 13. The vessel carried barrels of sugar, between the tiers of which layers of sugar cane were placed, in order to properly dress the cargo. After five days' navigation, five days of broiling calms and storms followed by rains, the captain, in order to rest the crew, decided to drift in the Strait of Florida without using sails. Passing out of the strait, the winds became steady, and the men went to work with a will to make sail, showing no trace of fatigue or malady. July 1, namely, eighteen days after the departure from Havana, 2 seamen fell sick, and died within a few hours of each other on the fifth day of their illness. July 2, another sailor was taken ill, but it is recorded that "with strong doses of the sulphate of quinine and with violent purgatives, he was cured after ten days." On successive days, 6 other persons were stricken, including the captain. All were dosed with quinine and cathartics and recovered more or less promptly. Altogether, among the 16 persons aboard, there were 9 cases of sickness and 2 deaths. In this condition the ship entered the port of Saint Nazaire, twenty days after the last death and ten days after the inception of the final case of suspicious illness. Since no case of sickness had occurred during the last ten days and all were well on board at the time of arrival, the vessel was punctually given pratique, in conformity with the French sanitary regulations.

The *Anne-Marie* lay near the shore, not far from the railroad. At her side were 2 other vessels, the *Chastang*, belonging at Indred, and the *Cormoran*, of the imperial navy. The latter vessel was loading

boilers from the former. The crew of the *Anne-Marie* was disbanded and the captain, who had not yet recovered robust health after his recent illness, went to Paimboeuf to recuperate. The discharge of the cargo was entrusted to 17 stevedores, all hale and hearty men.

From July 25 to July 29 the *Chastang* lay near the *Anne Marie*. Some of the men of the *Chastang* went aboard the *Anne-Marie* and paid a visit of a quarter of an hour's duration. July 29, the *Chastang*, with a crew of 5 men, left for Indret, a place 25 miles above Saint Nazaire. They arrived at Indret the same day. A mechanic on the *Chastang* sickened August 1 and died in four days. At about the time of the mechanic's death 3 men of the crew of the *Chastang* were taken with the same symptoms. The clinical picture was that of yellow fever. The news of what had occurred at Indret had not yet reached Saint Nazaire when, August 2, the first officer of the *Anne-Marie*, a robust man, aged 28 years, died after being ill of yellow fever for sixty hours. The next day, a cooper, who had spent several days in the hold of the *Anne-Marie* engaged in repairing sugar barrels, fell sick of the same disease and died in five days. August 4, a master stonecutter, who worked on the harbor front, 260 meters from where the infected vessel was stationed, acquired the disease, and after six days died. He had had no communication with the ship, no contact with the men or merchandise of the vessel. August 5, 5 stevedores from the infected ship were attacked. Three died in about four days, the other in eight days. August 7, there were 3 more cases, and 2 others the following day. A woman who sold old clothes, sails, and cord was taken sick of yellow fever August 6. She had received in her house 2 seamen of the *Anne-Marie* and had bought from them some discarded garments and odds and ends of canvas and cordage. The next day, a prostitute, aged 55, who had intimate relations with the stevedores of the pest ship, was prostrated with the same malady. A laborer, engaged in handling the cargo of the *Anne-Marie*, lived with a cobbler at a long distance from the port. The cobbler, who sat at his bench from morning till night and never moved from the place of his work, was stricken with yellow fever and died in a few hours. His guest, the laborer, and the laborer's wife both took the disease, but got well.

The *Cormoran*, with 6 men in the crew, was for four days (July 31 to August 3) near the *Anne-Marie*, loading boilers, as has already been mentioned, from the *Chastang*. The *Cormoran* had no communication with the *Anne-Marie*, and it is explicitly stated that she was exposed only to the emanations that issued from the ballast of the infected vessel during the discharge of cargo. The *Cormoran* went to Lorient, a place near Saint Nazaire, August 10. Four days later, 2 of her crew showed symptoms of yellow fever and were dead in forty-eight hours. The necropsy confirmed the diagnosis. Two lighters were also anchored near the *Anne-Marie*. One, the *Jean Bart*, had a crew of 2 men; aboard the other, *Pere Eugraud*, were 2 men and a woman. A man of the crew

of 1 of the lighters had been on the *Anne-Marie* for a few minutes only, but some of the lightermen had assisted at the funerals of the victims at Indret. All the 5 persons on the lighters suffered from a disorder which, though it had not the typical characteristics of yellow fever, bore a close resemblance to the milder form of the disease.

Still other vessels were infected from the *Anne-Marie*. A steamer that ran between Saint Nazaire and Lorient, known as *No. 6*, was for two days (July 28 and July 30) alongside the *Anne-Marie* and had communication with the stevedores. *No. 6* left Saint Nazaire July 30. During the trip to Lorient 1 of the stokers fell ill. He died in six days. About the same time the ship's boy took the same disease, but recovered.

A three-master, the *Dardanelles*, lay side by side with the *Anne-Marie*, August 2 and August 3, in such a position that to go ashore from the first it was necessary to cross under cover of the second. The ship's boy of the *Dardanelles* suffered a typical attack of yellow fever, but did not die.

A vessel from Marseille had been anchored in the harbor of Saint Nazaire from June 23. In order to prepare for her departure she was put alongside the *Anne-Marie* exactly in the position previously occupied by the *Dardanelles*. This vessel, after her departure, spent two days at Belle Isle. She then went to sea and lost her second officer from yellow fever. The officer fell sick August 5 and died after seven days. Twelve days after his death the ship's boy presented the same symptoms, including black vomit, and died in nine days. On the 26th the apprentice developed the disease, but recovered. August 29 a seaman took to his bunk with the malady; September 11 the captain sickened. During the next month 6 other men were prostrated by the disease. One of them died on the fifth day after invasion, the others recovered.

Altogether, the *Anne-Marie* infected 7 vessels, on which there were 40 cases of yellow fever and 23 deaths.

At Montoir a doctor named Chaillon was taken sick with yellow fever and died in four days. He had been in attendance on a patient who had worked as stevedore on the *Anne-Marie*.

The records of the epidemic at Saint Nazaire show that all the infected ships were stationed down the wind from the *Anne-Marie*. The fact is established by the data of the meteorological and maritime observer at Lorient. It is interesting to note that a ship of the imperial navy, the *Chandernagor*, and a passenger transport, the *Lorientais No. 8*, posted near the *Anne-Marie* but up the wind, were perfectly immune from yellow fever. The distance of anchorage and the length of time passed near the infected vessel seemed to have had decided influence in determining outbreaks of the disease. The prevailing temperature did not appear to have any influence. The daily temperature during the epidemic oscillated between the maxima of 21° and 25.5° C. and the minima of 11.8° and 17° C.

H. de Gouvea, in his article already referred to on mosquitoes and

yellow fever, published October 12, 1901, in *Le Bulletin Medical*, Paris, referring to the epidemic just described, says :

All these facts adapt themselves in a perfect fashion, in our opinion, to the theory of the propagation of yellow fever by mosquitoes. We may assume at the outset that, during the loading of the vessel at Havana, a certain number of mosquitoes, previously infected by sucking the blood of yellow-fever patients living in the near neighborhood, could enter the vessel's hold filled with cases of sugar and many stalks of sugar cane placed as a filling in the angular spaces of stowage to hold the cases in place and prevent friction. The stalks could have furnished the mosquitoes with necessary nourishment during the voyage.

During the broiling calms that followed five days after the departure of the vessel from Havana, the mosquitoes, excited by the heat of the atmosphere and of the hold, could very easily pass the defective bulkhead that separated the hold from the lodgment of a certain number of the crew and installing themselves in that place sting the sailors who, as we have seen, were at the time enjoying a period of repose, and thus inoculate them with the germs of the disease. The infection of the stonecutter who was at a great distance (260 meters) from the vessel, and who had had no contact with the ship, is explained in the present state of our knowledge in the following way : The infected mosquitoes escaping from the hold of the vessel and carried by the wind that blew in the direction of the workman, fixed themselves upon and stung him. The infection of the physician of Montoir, Dr. Chaillon, is explained in the same manner by the stings that he had received during his prolonged visit to the patient whom he treated, a stevedore of the *Anne-Marie*, suffering from yellow fever and living in a room on the ground floor in a marshy region where paludal fevers prevailed.

All the other cases of infection are explained very simply since they all occurred in individuals who had been for a longer or shorter time in the hold of the vessel or in individuals who, like the sailors of the other vessels, had been down the wind from the infected ship. With all the cases of yellow fever that occurred at Saint Nazaire and Montoir, the malady was not propagated by any of the effects of the crew, taken with them to their families nor by the ship's cargo sent directly to Nantes by the railroad.

Following the epidemic at Saint Nazaire there were reports of the importation of yellow fever in many of the ports of France, not only Mediterranean, but those of the west and north as well. There was, however, no diffusion of the disease.

1862. A vessel named the *Harriet* arrived, in the year 1862, at Havre with yellow fever aboard. The cases were so numerous that the authorities were forced to open the lazaretto at Tatihou, near Cherbourg.

1870. At the time of the epidemic in Spain, a vessel named the *Argos* arrived at Marseille from Barcelona with yellow fever aboard. The cases were all cared for in the lazaretto, except 1 seaman, who went to Marseille by land, was attacked by yellow fever, and died in the municipal hospital. Fortunately, there was no spread of the disease.

YELLOW FEVER IN ITALY.

The history of the two epidemics in Italy alleged to have been yellow fever, namely, those at Leghorn in 1804 and at Torre Annunziata in 1883, are of interest because of the heated discussions that arose as to diagnosis and the strenuous opposition that was made against branding the affected communities with the name of yellow fever, conditions

recalling the story of many an epidemic that has prevailed in various localities in the United States. The diagnosis in these two epidemics was so obscured by controversy that it will always be open to question. It depends upon the relative value that the student of their history places on the documentary evidence left by the physicians and public officers who had to deal with the disease.

1804. A Spanish ship, the *Anna Maria*, entered the port of Leghorn, August 18, 1804. On a voyage from Havana to Cadiz this vessel had lost almost the entire crew from yellow fever. At Cadiz the ship was refused permission to enter port, but was allowed to recruit the crew in quarantine. Through some irregularity the *Anna Maria* was given clean papers at Cadiz and, July 10, passed Gibraltar and proceeded to Alicante, where she received free pratique. The vessel sailed from Alicante August 9, and reached Leghorn August 18. Owing to the prevalence of yellow fever in Spain, special sanitary restrictions had, since July 17, been placed on all vessels arriving at Leghorn from Spanish ports. There had been sickness on board the *Anna Maria* on the passage from Alicante to Leghorn. The declaration of the captain, supported by oath, and the liberal donations of money made by the owner of the cargo, appear to have been effective in quieting all apprehensions at Leghorn. The ship was given free pratique. Two sick men taken from aboard were carried ashore and lodged at an inn in the Strada Pescheria Vecchia. These men died three days after, and a few days later 12 persons at the inn were taken sick. All the cases ended fatally. A Neapolitan who had left the inn at the first appearance of the disease was attacked ten days after and died in another neighborhood. A French butcher who took breakfast at the inn in the Strada Pescheria Vecchia died of the disease in ten days. Soon after his wife, the woman who owned the house in which he lived, and a friend, an officer of the French army, died of the same affection. At the time these events were occurring at the inn, another focus was formed at a bakery in the Via San Antonio. A baker had brought from the infected ship a quantity of sacks which were to be filled with biscuits. The bread was baked in the night and, in the intervals between ovenfuls, the bakers rested themselves by lying down on the empty bags. In a few days these men were stricken with a strange malady. Suspicion was directed against the *Anna Maria* as the source of the disease, and sanitary guards were stationed aboard. In their turn, the guards acquired the disease.

The cargo of the *Anna Maria* consisted of sugar, hides, and wood used in the art of dyeing, and was stored in warehouses in different parts of the city. In the neighborhood of these magazines the disease gained quick headway. The porters who handled the goods and the custodians of the warehouses were taken with the disease. Two porters and 1 custodian died. Thus, spreading by degrees, the malady extended throughout the city of Leghorn. At that period Leghorn had a popula-

tion of 60,000, not counting the men of the French garrison. About 7,000 inhabitants fled to Pisa. The French soldiers were transferred elsewhere. None of these persons who left the city carried the disease to their new residence.

Two French physicians, Lacoste and Dufour, made a study of the malady. Lacoste had been for many years a medical officer of the army in the French Antilles. Dufour was a sanitary official of Leghorn and had conducted many necropsies. Lacoste and Dufour made post-mortem examinations of the bodies of the French butcher and the officer of the French army. As to their diagnosis, they only reported that the men died of a contagious disease. They did not assign to the disease the name of yellow fever.

After the flight of the 7,000 persons to Pisa, a sanitary cordon was thrown about Leghorn, thus cutting the city off from the rest of Tuscany. In October, the government of Tuscany sent to Leghorn a commission composed of the celebrated Professor Palloni and Drs. Bruni and Bertini. The figures showing the ravages of this epidemic are very conflicting. Lacoste says that 1,900 persons died during the epidemic, Coppie says 1,500, and Palloni 700. These discrepancies can be readily understood when account is taken of the state of panic that prevailed and the confusion that invaded the families of the sick or dead when they were turned out of their houses and the habitations burned to the ground. According to the reports of Palloni, there were 7 deaths in August, 51 in September, 204 in October, 390 in November, and 3 in December.

The government commission was composed of men of experience and learning, who studied the epidemic thoroughly and suggested the wisest measures of sanitation. But it is a curious fact that when it came to defining the malady they remained mute. The only conclusion that can be drawn is that silence on this point was a condition imposed upon them by their government with a view to minimising the commercial damage that in a maritime city would be attendant upon the epidemic diagnosis of a disease capable of spreading to the shipping. In fact, seventeen years after, Palloni, in giving his advice on yellow fever to the sanitary authorities of the port of Marseille, confessed openly that there had been at Leghorn in 1804 an epidemic of yellow fever.

1883. The small epidemic at Torre Annunziata alleged to have been yellow fever occurred in 1883 on the eve of the devastating prevalence of Asiatic cholera at Naples the following year. The interest it probably would have otherwise attracted was lost in the greater epidemic that entirely occupied the activity and study of Italian physicians and epidemiologists.

The first case occurred June 19 in the person of a tavern keeper, aged 60, from Ischia. This man went directly from Ischia to Torre Annunziata, May 29, to transact business as a wine merchant. His case was

diagnosed as one of grave icterus and he died July 8, in Via Cisterna. A few days later another man, 80 years old, living in the Via del Popolo, two or three blocks away, died with the same symptoms. The attending physicians made a diagnosis of acute yellow atrophy of the liver. The third case was that of a woman aged 70 years who died August 25, after an illness of eight days. She lived in Via Garibaldi, within two blocks of the first cases. The same diagnosis of acute yellow atrophy was made.

Early in September, several persons living in Via Cisterna were taken sick about the same time and with the same symptoms. An alarm arose and strict sanitary measures were employed. September 6, a custom-house clerk in Via Cisterna was taken ill. He had a chill, pains in the back, high fever, slow pulse, severe headache, and black vomit. He died in 7 days. Cases continued to appear in the same neighborhood until October 13. There were in all 13 cases and 7 deaths. In September, a commission of medical men from the University of Naples investigated the disease. Among them was Professor Somma, who died in the cholera epidemic at Naples the next year. After much discussion the members of the commission admitted the specific nature of the malady, but did not give it a name. However, Professor Somma, in a concise letter written September 24, 1883, to Dr. Gennaro Cozzolino, made the statement that the disease prevailing at Torre Annunziata was yellow fever. During the height of the epidemic the most careful investigations were made; necropsies were conducted by the most skillful pathologists of Naples; a special lazaretto was established, and the most stringent measures of isolation and disinfection insisted upon. The disputes between medical men were numerous and more or less violent. As a result, the consensus of opinion excluded yellow fever. Icteroid typhus and infective fever characterized by jaundice were the diagnoses settled upon by the different physicians who went so far as to give it a name.

Since 1883. It is a frequent occurrence in Italian ports up to the present time to have vessels arrive from South American ports with a history of yellow fever on board during the voyage. But no cases of yellow fever on shore have been registered since 1883. Vessels with suspicious histories of the nature mentioned are invariably sent for disinfection to the Italian national lazaretto on the island of Asinara.

YELLOW FEVER IN GREAT BRITAIN.

1817. The brig *Britannia*, from Liverpool, after being in the port of Falmouth for six weeks, began to discharge a cargo of bales of cotton. No sooner had the unloading begun than yellow fever developed, but the disease was limited to the crew of the vessel.

1852. In the month of November, the steamship *La Plata* arrived at Southampton from Saint Thomas. Yellow fever developed aboard

while she was in the port of Southampton, and of the 14 seamen who were taken ill 7 died.

1857. The steamship *Tamar*, which was suspected of being responsible for the grave epidemic of yellow fever at Lisbon, Portugal, in 1857, entered Southampton shortly afterwards. She had had deaths on the passage from Spain and gave rise to several cases of yellow fever at Southampton.

1864. In this year there were a few cases of yellow fever aboard a vessel lying in the harbor.

1865. In the month of September a sailing vessel arrived at Swansea from Santiago de Cuba. Yellow fever broke out aboard while she was in port and 15 persons died. There were no cases reported ashore.

YELLOW FEVER IN AUSTRIA.

1894. The history of yellow fever in Europe concludes with 2 deaths from the disease in hospital in Trieste. The Italian steamship *Colombo* returned to Genoa from Brazil, having had yellow fever aboard. She was detained for disinfection. Two of her crew went by land to Trieste, where they were stricken with yellow fever and died in hospital. There is no record of an extension of the disease.

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YELLOW FEVER INSTITUTE, BULLETIN No. 9.

Treasury Department, Public Health and Marine-Hospital Service.

WALTER WYMAN, Surgeon-General.

Are Vessels Infected with Yellow Fever?

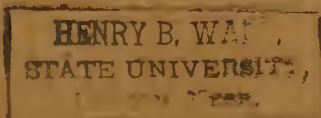
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Section C.—TRANSMISSION.

J. H. WHITE, Asst. Surg. General, Chairman of Section.

ARE VESSELS INFECTED WITH YELLOW FEVER?—SOME PERSONAL OBSERVATIONS.

By Surgeon H. R. CARTER.

JULY, 1902.

In a paper read before the American Public Health Association at Buffalo, September 18, 1901, Dr. Doty, the quarantine officer of New York, affirms the absence of secondary cases of yellow fever aboard vessels—i. e., that while cases of this disease contracted ashore develop aboard vessels, yet none are contracted aboard the vessel itself—that is, the vessel does not become “infected” with yellow fever.

The experience of other quarantine officers has been different, and it may be of service then to group some cases already of record in which the contrary was observed. It is not proposed to collate a number of examples of vessels aboard which yellow fever was contracted, from the literature of the subject, but to give very briefly the history of some such vessels personally observed by the writer, from his own notes, during a four years' service (1888 to 1891, inclusive) at the quarantine of the Gulf, Chandeleur and Ship islands. Here were received all vessels believed to be infected with yellow fever bound for all of the Gulf ports, except for New Orleans and from Tampa south. Consequently our clientele was considerable. The bulk of them, however, although certainly the worst class of vessels which entered the Gulf of Mexico, were not, in my opinion, “infected” when I received them—i. e., yellow fever could not then have been contracted aboard them.

I will premise here that I accept without reservation the conveyance of yellow fever by an infected mosquito of a certain kind, and that to

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me a vessel "infected" with yellow fever is simply one which is harboring these infected mosquitoes. Whether they came aboard already infected or, being aboard, became infected by feeding on cases of yellow fever developing aboard ship but contracted ashore, can in general be determined from the history of the spread of the infection. Indeed, it was primarily the history of these and other ships which led to the (tentative) formulating of the laws of the "interval between the infecting and secondary" cases of yellow fever and the "period of extrinsic incubation of places" of that disease, which, and much else, are so clearly explained by the conveyance by a mosquito host.

The deductions as to the disease being contracted aboard the vessels, when such deduction is made, are, however, independent of the assumption of any theory of conveyance. I do assume, however, that the period of incubation of yellow fever, rarely, if ever, exceeds six or six and one-half days.

1888.—SHIP ISLAND.

I. Norwegian bark *Magnolia*, 946 tons, fifty-six days from Rio de Janeiro via Pensacola Bar, rock ballast. Left Rio de Janeiro May 20; left 2 men sick in hospital and had 1 aboard, considered yellow fever. Master sick third day out, May 22; died, May 27. All well till June 1, then several (3) got sick at once. First mate sick, June 11; died, June 17; black vomit. All were sick on the way up except 2; 21 on crew list including the 2 men left in Rio de Janeiro. One of these who escaped fever had had yellow fever, and the other was a lad from Dantzic on his first deep-sea voyage. In all 17 men were sick of fever en route, of whom 5 died. The last case, Elias Eliassen, developed June 14. Here, save the captain, all sickened not less than eleven days after leaving Rio de Janeiro, and the first mate and Eliassen on the twenty-third and twenty-sixth day, respectively. They then contracted yellow fever aboard ship.

The picture is that of an infection introduced aboard the vessel by the men who sickened in Rio de Janeiro—i. e., there were uninfected *stegomyia* aboard which were infected from these cases and conveyed yellow fever to the remainder of the crew, except the captain, who contracted it ashore. I did not record the dates of the cases of the men left at Rio de Janeiro; it was shortly before clearing. The interval between an infecting and a secondary case is almost always fourteen days or over.

II. Italian bark *Riagino*, Rio de Janeiro, for Pensacola, fifty-one days out; rock ballast, 560 tons. No sickness in Rio de Janeiro until just before leaving, then sent 2 men to hospital. Left five days after. Log shows men were taken June 4 and June 6 and removed on June 6. Sailed on June 10. No one had been ashore save master and steward, using a harbor boat.

First case reported sick en route June 21; 1 next day; 6 sick en route;

3 deaths, June 28, June 29, and July 14, all with black vomit. Crew refused duty at second death. Last case well July 13. Sixteen on crew list; 2 in Rio de Janeiro. Master had had yellow fever; steward sick just after leaving, not considered yellow fever.

Six cases developed ten days after leaving Rio de Janeiro. Same remarks as were made of the *Magnolia* apply here.

No record is made of where these 2 vessels lay in Rio de Janeiro, the writer not then appreciating the importance of this.

1889.

My notes for 1889 are lost, and indeed there may have been in 1888 more than the 2 vessels given above, which should have been included in this paper; but my notes, taken at first solely with the view of determining the period of incubation of yellow fever, give data on only these two sufficiently definite to determine that they were infected—i. e., that yellow fever was contracted aboard.

1890.

III. British ship *Avon*, in rock ballast; 22 in crew, 4 immune to yellow fever. Sailed from Rio de Janeiro April 20. All well in port and en route until thirty-eight days out, when a boy in port watch sickened with yellow fever. Taken to hospital, Gulf Quarantine, on third day, and died on sixth day. Another case developed two weeks later in a quarantine attendant who helped me clean up the room, sail locker, in which the boy was sick aboard ship.

It is remarkable that there should have been only 1 case of yellow fever among the crew aboard this vessel. At the time it was ascribed to the fact that this boy, the only one on the port watch, helped a man, shipped in Rio de Janeiro and immune to yellow fever, overhaul his chest a few days before the boy was taken sick. Whether there was an infected mosquito in the chest which had survived this length of time, or whether there was any relation between the chest and the fever, may be a question. It in no wise affects the present question, that the disease was contracted aboard. It was the first case seen at this station that year.

IV. British ship *Curlew*, from Rio de Janeiro, with rock ballast. No sickness was reported en route, in port, or on arrival. She was cleaned July 22 to July 23, 1890, and disinfection completed July 25, in the afternoon. One case of yellow fever developed July 27, the sixty-fourth day out, in the early morning before day.

V. British ship *Chippewa*, from Rio de Janeiro, with rock ballast. No sickness was reported in port, en route, or on arrival. She was cleaned July 26 and July 27, and disinfection completed July 28. One man, the quartermaster, developed yellow fever July 29, at night, sixty-eight days out from Rio de Janeiro.

The *Avon* made no port after leaving Rio de Janeiro and communicated with no vessel en route. The other 2 made no port save Pensacola Bar, and communicated with no vessel save the pilot boats there and off Mobile Bar. The infection in these 3 vessels, then, must have been contracted aboard. They lay in open roadstead at my station, $1\frac{1}{2}$ miles off shore and about $\frac{1}{2}$ mile apart, and there was no visiting between them and none of their crews was ashore.

VI. Spanish bark *Castilla*, fifteen days from Cienfuegos via Round Island Quarantine, in rock and earth ballast; 14 in crew. Eight days out from Cienfuegos to Round Island. All well in port, en route, and on arrival. Mate sickened fourth day after arrival at Round Island while discharging ballast. Vessel sent here in tow August 22. Mate had yellow fever; died on the sixth day of illness. Captain developed yellow fever day after mate's death; taken to hospital. No other cases of sickness aboard; the remainder of the crew are, save 1, Manila men, and all probably immune to yellow fever, being mainly residents of Cuba for many years.

Here 2 men developed yellow fever, 1 twelve and 1 seventeen days after leaving Cienfuegos. The infecting mosquitoes may well have been harbored in the hold, which the mate would probably not have visited until he anchored at Round Island and began discharging ballast, and in which the master would not be apt to go while the mate was on duty.

VII. Spanish bark *Grand Canaries*, seven days out from Havana July 7. All well in port, en route, and on arrival and while in quarantine. Crew probably all immune to yellow fever, being mainly Manila men and old residents of Havana.

O. F., quarantine employe, went aboard as ballast master; next day developed yellow fever, July 11. This man had been exposed to no possible source of infection for the six months previous except this vessel. A case nearly similar to the above occurred in 1889, but I have no notes of it.

VIII. Norwegian bark *Queen of the Seas*, in rock ballast, Rio de Janeiro for Pensacola, fifty-four days out. Left Rio de Janeiro with 17 men; 6 deaths en route. All well in Rio de Janeiro. Lay at Mocanque, a healthful part of harbor. None save master allowed ashore, but he went in ship's boat. Left 1 man at Rio de Janeiro—consumption. Shipped 1 man, a negro, in his place. Sailed April 23; master sick April 26; second mate sick night of May 10; 2 men May 11; 1 man May 12; 2 men morning of 13th; 2 during day of 13th; 1 man sick and 1 died 15th; 1 man died 17th; 2 sick 17th; 1 died 19th; 2 died 21st and 22d; 1 sick 21st; 1 died 25th; 13 sick en route, 5 died. The man shipped in Rio de Janeiro (negro) and 1 of the others immune by previous attack. The picture is very clear of a clean ship, infected by the illness of the master contracted ashore—i. e., had uninfected mosquitoes aboard, which became infected from the master sick of yellow fever, and conveyed it to the crew.

1891.

IX. British ship *Curlew*, fifty-seven days from Rio de Janeiro for Pensacola. Lay in the Gamboa last eight days. Two men sick February 27, taken to hospital that day; sailed March 1. Master sick March 1; 5 men besides him that night. Two men March 4, 1 March 5, and 2 more during the day. Two men sick March 7. Two men died the 19th, sickening the 13th and 15th, respectively, both with black vomit. All aboard here, 19, were sick en route except 1, a Barbados negro; but don't believe all had yellow fever, the crew having been badly frightened. The earlier cases and the 3 who died were undoubtedly yellow fever, as were the steward and mate. Here we have 2 cases, at least, developing thirteen and fifteen days after leaving Rio de Janeiro.

X. Swedish ship *Condoren*, seventy-nine days out from Rio de Janeiro via Pernambuco for Mobile. Rock and earth ballast; 18 in crew. All well in port. Lay in Gamboa last five days. No shore leave allowed, but took ship's boat to go ashore. Sailed March 3; 3 men sick March 5; 16 men sick, all told, up to March 26, and 6 deaths. Last man got sick March 26, when she put into Pernambuco short-handed and sent 3 sick men to hospital. Two men sick March 20; 4 men sick March 18; 1 man sick March 26 (really night of 25th). At Pernambuco she lay eleven days and was disinfected by sulphur. Shipped 8 new men, 4, probably 5, of them immune to yellow fever. Developed no sickness on the rest of the way up. Here 4 men developed yellow fever fifteen days from Rio de Janeiro.

XI. German ship *Gustav and Oscar*, Rio de Janeiro for Pensacola. Lay at Cobras, a healthful place. One case yellow fever at Rio de Janeiro, March 22, sent to hospital March 24. No shore leave allowed. Sailed from Rio de Janeiro April 1; first case sickness April 7, 2 men; 3 next day; 1 next morning, and 2 during the day of the 9th. One death on the 10th, leaving 6 men sick. Captain sick on the 10th at night after supper. Last case on 14th. Two deaths on 11th; 1 on 12th. Crew list shows 21 men left Rio de Janeiro; 14 sick and 4 deaths en route. It is reasonably certain that 4 of the remaining crew were immune to yellow fever by previous attack.

XII. Norwegian bark *Crown Prince*, fifty-eight days out from Rio de Janeiro for Ship Island. Lay at Moncanque. No sickness aboard in Rio de Janeiro. No shore leave granted, and did not use ship's boat to go ashore. Sailed April 29. Master sick second day out (April 30). Next case May 16; 3 (2 aft and 1 forward) became sick. May 17, 2 sick in morning, 1 in the day. May 18, 3 men in fore-castle sick. May 20, 2 sick, 1 death. May 21, 1 death, 1 sick. May 23, 2 deaths. May 24, 1 sick. May 28, 1 death last night. May 29, 1 sick this morning. M 1 death. The 1 case on the 29th was the last case taken sick. There were 14 men aboard and every man had fever, 6 dying. She put into Barbados on June 10, disinfected and shipped (in quarantine) 4

new men, 1 probably unacclimated. No more sickness en route. All of these cases except the captain's were not less than sixteen days from Rio de Janiero before developing.

XIII. French ship *Emily Postel*, twelve days from Vera Cruz via Pensacola quarantine. Had "sickness" aboard just before leaving Vera Cruz, 1 man. Sailed from Vera Cruz July 28; no sickness since until crew went to discharge ballast, August 12. One man sick yellow fever August 15, 2 men the same, August 19, and 1 man August 20. Disinfection by sulphur was done on the appearance of the first case of yellow fever and no case occurred save the above. All were developed more than sixteen days after leaving Vera Cruz, hence from infection on board. The history points to infection (infected mosquitoes) in the hold.

The picture given by the *Curlew* and *Conderen* are those of disease conveyed by mosquitoes coming aboard already infected just before they sailed. The infection was not introduced by the men who first sickened, the interval between them and the next cases was too short. Observe that they lay in the Gamboa, directly in the lee of a town badly infected. The other two give the usual history of a clean place (town or vessel) infected by some one developing yellow fever, contracted elsewhere, in it.

XIV. Dr. G., assistant surgeon U. S. Marine-Hospital Service, developed yellow fever June 18 at the Gulf Quarantine Station, and died June 29. He was immediately from New York, where he had been on duty some months, and had been at the station but fourteen days when he was taken ill. There had been no case of yellow fever at the station that year. There were a number of vessels in quarantine, but the *Gustav and Oscar* (No. XI) was the only one I judged to be infected. On this vessel, as on the others, he had been with me inspecting, opening up drawers and boxes, and going into every compartment, etc., for the disinfection. I thought his infection was from this vessel. It was certainly from some vessel.

I think it will be granted from the above that the ability of a vessel to carry the infection of yellow fever is no myth. Here are 13 vessels which did so carry it collated from only three years' observation at a single station. Such vessels are indeed rarer, much rarer, now than they were before 1894, yet they still come. I saw 2 at Tortugas in 1894. Other cases are reported by Geddings and by Echemendia at the same place and at Port Tampa quarantine. Rosenau reports a case contracted aboard the steamship *Vigilancia*, from New York, plying between New York and Vera Cruz via Havana, in 1899. The steamship *Bodo*, last year (1900), from Bocas del Toro, for Mobile, developed 3 cases of yellow fever, seven, eight, and nine days out from Bocas del Toro. It would not be difficult, I think, to multiply instances of recent date, yet that they are rarer is without question. On the factors which have brought this about we can barely touch.

Obviously there are two methods by which vessels can become infected. (a) A case of yellow fever contracted elsewhere may develop aboard a vessel already harboring *stegomyia* mosquitoes which become contaminated from it. (b) The *stegomyia* mosquitoes may come aboard already contaminated. In the first case, there being nearly always over two weeks between the infecting and the first secondary cases of yellow fever, it results that, if the first case occurs after leaving port, vessels, even sailing vessels, from Cuba and the Caribbean Sea will generally reach quarantine and (if at a southern station) be disinfected—i. e., mosquitoes killed, before it is time for the secondary cases to develop, or, indeed, to be contracted. This agrees with all observation. In vessels infected in the second way, cases of yellow fever may occur after a very short or no interval from leaving port. The causes, then, which have lessened the number of infected vessels at United States ports, are—

1. The very great falling off of vessels from Rio de Janeiro and Santos since the establishment of the Brazilian Republic. This does away with the bulk of the "long-trip vessels" we used to have, which are the only ones developing secondary cases en route if infected by a case of yellow fever developing aboard. (Vide *a.*)

2. The replacing of sailing craft by steamships. That steamers convey yellow fever less frequently than sailing vessels has long been known. This is because they lie a much less time in an infected port, and the discipline of their crews is better; no shore leave means no man goes ashore. They also make quicker trips, and thus are not apt to develop secondary cases en route, even if yellow fever contracted elsewhere develops aboard and they have the *stegomyia* aboard. It is also to be noted that the worst parts of the harbors of Havana and Rio de Janeiro, above San Jose wharf and the Gamboa, have never been berths for steamships. Note, too, that the sailing vessels displaced are the foreign sailing vessels; the American schooner was less often infected than foreign vessels.

3. Especially since 1893, and to some extent before supervision had been kept by United States sanitary inspectors in the more dangerous yellow-fever ports over vessels bound for the United States, especially of passenger vessels. Certain anchorages have been recommended as safe, others have been forbidden, notably the Gamboa at Rio de Janeiro and certain wharves and parts of the harbor at Havana. Passengers who it is believed will develop infection aboard have been barred; shipment of new men in the infected port carefully supervised; vessels in which yellow fever has occurred in port are disinfected before leaving, and many other measures taken to have the vessel leave port clean, or as nearly clean as commercial considerations allow. In general, the vessel owners, especially of the regular lines, have given hearty cooperation in these measures, as well as in keeping the crew aboard and in confining the visits of such officers as must go ashore to daylight.

These restrictions, especially the last, have by no means been absolute for all classes of vessels, but are well observed, in Cuban and Mexican ports at least, by probably over five-sixths of the tonnage. The sanitary measures to avoid infection (3) and the proportionate substitution of foreign sailing vessels by steamships (2) are without doubt the main factors acting in cooperation in lessening the infection of ships. No one can read Burgess' list of infected vessels in Havana Harbor (Report, U. S. Marine-Hospital Service, 1896) without noting how great has been that decrease in recent years.

We have said that if a case of yellow fever develops aboard a vessel harboring the *stegomyia* mosquito (proper conditions of temperature being premised) that they may become contaminated by feeding on him and infect others. A vessel which has no *stegomyia* aboard is like "noninfectible territory" and will not communicate infection, even if cases of yellow fever develop aboard. I think it fair to say that vessels plying to and from southern ports of the United States will, during the summer season, generally have the *stegomyia* aboard, independently of its berth in tropical harbors, and may at times breed them in their water supply. This mosquito, however, seems to be rare north of Virginia Beach (its distribution has not been sufficiently investigated, however), and a vessel plying to and from a northern port of the United States would not harbor this mosquito unless it came aboard in the tropical port. Now how far this mosquito goes or is borne from shore has not, I think, been directly investigated, but we do know that the crews of vessels moored off from shore (say 200 or more fathoms) in that part of Havana harbor seaward from the line between the Sta. Catalina warehouses and the Machina wharf do not develop yellow fever (unless close to some vessel which is infected). This means that contaminated *stegomyia*, at least, do not go so far from shore. Lying then at the anchorages accounted safe in Havana harbor, where the passenger vessels for the United States lie, one would think that the probability of any *stegomyia* coming aboard would be small. At Vera Cruz the vessels must lie nearer shore (although to windward of it), and experience shows that the crews of vessels lying there are not entirely safe, as I believe them to be in Havana, although infection in the part of the harbor picked out as safe is decidedly rare. The anchorages in both harbors regarded as safe are well to the windward of the town all summer. A direct investigation of this matter—i. e., the presence of the *stegomyia* aboard vessels from northern ports in different parts of the harbor of Havana and other tropical harbors, should be made.

To sum up—

1. Vessels aboard which yellow fever had been contracted—i. e., vessels infected with yellow fever have not been rare, at least at southern quarantine stations.

2. Such vessels are much rarer since 1893, and are not very common now.

3. That the diminution of the number of infected vessels reaching United States ports is due mainly to the sanitary measures for avoiding exposure to infection in the foreign port, and to the substitution of steam for sailing vessels. To some degree the falling off of the vessels from Brazilian ports is also a factor.

4. That a case of yellow fever developing aboard a vessel plying between southern ports of the United States and the tropics will probably infect the vessel so that other cases can, if time be given, be contracted aboard her.

5. Such vessels, however, if short-trip vessels, not more than ten or twelve days en route after the occurrence of the case of yellow fever, will in general be disinfected at southern quarantine stations before any other cases have been contracted aboard, although harboring infected mosquitoes.

6. That a case of yellow fever so occurring aboard a vessel from a northern port of the United States would be able to infect her or not according to whether she had acquired the mosquitoes *stegomyia fas.* in the tropical port.

7. It is, in general, then necessary to disinfect all vessels running between southern ports of the United States and tropical ports if a case of yellow fever occurs aboard, no matter where it be contracted; while vessels running between northern ports and the tropics may, through precautions in tropical harbors, have no *stegomyia* aboard and are thus not infectable by cases of yellow fever occurring aboard.

8. Some vessels giving no history of yellow fever in port, en route, or on arrival—even when many days en route—are nevertheless infected and communicate the yellow fever to those who go aboard, vide Nos. IV, V, VI, VII. Note, also, the first case aboard the *Avon*, No. III, was thirty-eight days out from Rio de Janeiro. This is probably due to the infection (infected mosquitoes) in parts of the vessels unfrequented by the crew while en route, or to the crew being all immune to yellow fever.



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YELLOW FEVER INSTITUTE, BULLETIN No. 10.

Treasury Department, Bureau of Public Health and Marine-Hospital Service.

WALTER WYMAN, *Surgeon-General.*

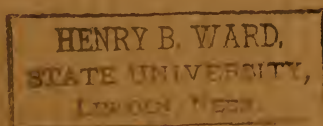
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By Surgeon H. R. CARTER.

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Section C.—TRANSMISSION.

Asst. Surg.-Gen. J. H. WHITE, Chairman.

THE METHODS OF CONVEYANCE OF YELLOW FEVER INFECTION.

By Surg. H. R. CARTER.

JULY, 1902.

Whether further experimentation is desirable before we accept without reserve the *Stegomyia fasciata* contaminated by a patient sick of yellow fever as the *only* natural means of conveying yellow fever may be a question, yet I think that the argument for its being in nature conveyed only by a host, and doubtless a mosquito host, is strong. It is assumed that there is no question that it may be thus conveyed.

1. Analogy: Of such diseases as have been fully investigated, all that are conveyed from living hosts are caused by animal parasites. Also of these diseases each one *is conveyed (in nature) only by means of a host of a given genus.*

2. Agreement of facts observed about the propagation of yellow fever as it occurs in nature with the necessary deductions from the theory of conveyance by this host.

(a) The fact that the disease is not directly propagated from the sick to the well, that it is propagated only by means of an infected environment.

(b) That a man sick of yellow fever may infect his environment.

(c) The existence of "infectible" and "noninfectible" territory. (a)

a An "infectible" place is one which, if cases of yellow fever be introduced therein, becomes infected—i. e., capable of inducing yellow fever in those who, susceptible to that disease, visit or live there. A "noninfectible" place is one which will not become infected even if cases of yellow fever be introduced. In such a place yellow fever is not a transmissible disease. The theory of conveyance by a host would explain the difference by the presence of the proper host (*Stegomyia fasciata*) in the one and its absence in the other.

(d) The relation of the spread of the disease to cold weather, altitude, and excessive dryness.

(e) The *close* correspondence of the periods of incubation observed after one exposure to infection in the natural way (12 cases observed by myself) with the periods of incubation after mosquito inoculation by Reed—12 cases also. Note that yellow fever caused by the hypodermatic injection of blood or strained serum from a yellow-fever patient gave neither the same period of incubation nor the same interval (f)—i. e., this is *not* a natural method of conveyance.

(f) The existence of a fairly definite interval between the “infecting” and “secondary” cases of yellow fever in its development in an environment.

(g) The phenomenon of the “extrinsic incubation of places” in house infection agreeing with the time Reed determines must elapse between the feeding of a mosquito on a yellow-fever patient and the time it is able to communicate the disease to a well man. This is a most remarkable phenomenon and with (e) is scarcely capable of any further explanation than propagation by a host. (a)

(h) Hybernation of yellow fever in places like the north Gulf coast and Memphis, where mosquitoes hybernate, and failure to hybernate in subtropical places like Key West and Tampa, where mosquitoes do not hybernate.

(i) Conveyance by vessels, etc. In the same way the method of conveyance by a host is consonant with the prolonged and yet limited persistence of infection in places (houses); with the well-known influence of aeration as freeing a place from infection; with the habitual conveyance of the disease short distances “down the wind”; with the comparative safety of “daylight communication” with an infected place, etc.

(j) The fact that the *Stegomyia* has been found in all of the places known to be usually infectible by yellow fever which have been examined for it, should also be noted. That it is evidently, for the United States, an imported insect (although now acclimated) and has been conveyed along the lines of railroads and great rivers well agrees with the early history of yellow fever in the United States, and the fact that yellow fever spreads now in places in the interior which in past years were noninfectible. Note here that Las Animas (the yellow-fever hospital at Havana) was certainly not infected by yellow fever in 1899 or to July 15, 1900, and that we were unable, up to that time, to find any

a By the “extrinsic incubation” of yellow fever is meant “the time that elapses between the development of a case of yellow fever in an uninfected place and the date at which that place becomes capable of inducing yellow fever in those who are exposed there.” This the writer had from direct observation tentatively fixed at “usually in excess of ten days,” “the usual limits being from ten to seventeen days.” (Medical Record, June 15, 1901.) Reed gives the minimum time between the date of feeding the mosquito on the yellow-fever patient and the date at which yellow fever was conveyed by the same insect to a well man as twelve days.

of the "Finlay mosquitoes" there, although the black *Culex* was in myriads. It is but fair to say that our examination was not a complete one, at least not up to the time I left Havana, July 23, 1900.

(k) Good evidence, too, is the success which has attended the institution by Gorgas in Havana of measures for the suppression of yellow fever, based solely on this theory of propagation, and which would be inefficient against an ordinary bacterial disease propagated directly. If the result in 1901 be compared with the failure which attended the "campaigns of cleanliness" and general disinfection in 1899 and 1900, the evidence becomes more weighty. Note that against this theory can not be plead that yellow fever has also been suppressed or controlled, which has occurred, by measures not directed against the mosquito, because such measures always included the prompt isolation of yellow-fever cases and disinfection with sulphur dioxide, and *while not directed against mosquitoes, were efficient against them.*

(l) Now, is there any general fact established about yellow fever which is *incompatible* with this method of conveyance? I think not. The conveyance by fabrics would certainly be absolutely against this theory. This as a method of conveyance used to be generally admitted, but I think this was due less to the evidence therefor than from the analogy of other infectious diseases and because (since La Roche) the contrary view was scarcely advanced. The observation on Cuban and Mexican baggage (see a quotation, p. 5, Bulletin No. 6, of Sec. C, Yellow Fever Institute) are, I think, sufficient to negative the method of conveyance by baggage.

Surg. H. R. Carter, of the Public Health and Marine-Hospital Service,
* * * writes:

For the twenty years preceding 1899 the baggage from Vera Cruz, Havana, and Santiago de Cuba, on vessels arriving at New York, unless with yellow fever en route, entered without disinfection. The amount of this baggage from Havana and Vera Cruz is large, and it is not possible but that much of it came from houses infected with yellow fever and much of it was not clean. All of this baggage was opened at the custom-house at New York and handled in hotels there and at Saratoga, and no yellow fever is reported among the customs inspectors in New York, or at the hotels, during this time.

The baggage going from the same ports to Spain for the last thirty years is even more to be considered. Its amount has been enormous; much of it (from the class of people to whom it belongs) must have been foul. Some, the lesser part, it is true, of this traffic goes to the Mediterranean ports of Spain—Valencia, Malaga, and Barcelona, etc.—which at times, 1870 and before, have been "infectible places," yet, I think, we have had no yellow fever reported in the Peninsula since the epidemic of 1870.

Of course, negative evidence is convincing only in proportion to its mass, and that a piece of baggage or 100 pieces of baggage from an infected place did not convey infection to nonimmunes exposed to it, means little, yet the amount of this baggage is so large—I can not estimate it at less than that of 300,000 persons from Havana alone—that we must claim that a very large number of pieces of baggage from infected houses have been introduced into New York and Spanish towns, that numbers of susceptible people have thus been exposed under various conditions, but have not contracted yellow fever.

To me the mass of this evidence is sufficient to be convincing, and I count it proven

that baggage from Havana and Vera Cruz will not convey yellow fever directly to people after the voyage to New York or Spain, thus that yellow fever is not conveyed by mosquitoes carried in such baggage.

Whether this time element is necessary, of course, is not determined by these observations, but it is a factor in them.

Whether the rare cases of yellow fever we sometimes see contracted from infection aboard ship hitherto uninfected may be due to infected mosquitoes brought aboard in the hand baggage of passengers, and opened soon after coming aboard, may be a question. The sister who developed yellow fever aboard the *Vigilancia* en route from New York to Havana, is a case in point, and we occasionally see members of the crew with yellow fever. One occurred in Havana harbor on a Ward liner en route from Vera Cruz to New York in 1900. Other explanations of these cases may, of course, be possible.

With the above should have been considered in addition from 175,000 to 200,000 persons, troops, and families returned from Cuba by transport at the end of the war, with baggage and equipment. As to the positive instances of conveyance by baggage which have been reported, none that I have been able to inquire into personally, certainly exclude this method of conveyance. The reporter begins (as I did) with the assumption that yellow fever is conveyed by fomites, and as soon as he can show the introduction of fomites from an infected place, he is satisfied. He looks no further for any other source of infection. Strange to say, the *best* attested cases I have come across have not been those of conveyance by *packed* baggage, but by *clothing worn on the person*, sometimes for a number of miles, or hours through the sun and air, which is against all other experience of this disease. Of the older reported cases I have nothing to say; I can not examine them; only as none of the modern ones which I have been able to inquire into clearly exclude other means of conveyance, it is fair to at least doubt if the older reports are impeccable. Also it is common sense, that when there is a great mass of negative testimony on a subject, all tending one way, we may not accept a moderate amount of positive evidence in rebuttal unless its *data be conclusive*, and I think the evidence of the Cuban and Mexican baggage is great enough for this rule to apply. I think then we may reject the conveyance by fomites as not proven, and say that there is no good evidence in rebuttal of conveyance save by a host.

Now, let us look at this evidence. The argument from analogy, in this case has great weight. The presumption that it creates is strong.

For the second argument. It is indirect evidence, of course, yet it is the kind that we accept for the theories of the causation of other kinds of natural phenomena. That the deductions from the theory agree with the observations of the phenomena is the only evidence we have for the doctrine of universal gravitation, of the vibration of light, of the conservation of energy, etc., which physicists hold as beyond cavil. It is true we have been able to apply mathematics to these theories, and that the chain of phenomena which we can thus compare is much greater than we have in this instance; yet I think that we can fairly claim that in our case *all the phenomena which we have fully*

examined agree with the deductions from the theory and none disagree, and the *principle* of deciding on *the truth of the theory is the same*. I think then that the evidence (presumptive only) is good, that the only means of conveying yellow fever is by means of a mosquito host.

This evidence is indirect and presumptive only. Yet it seems easy to obtain *some* direct, although negative, evidence—i. e., to show that other methods (besides the host) do *not* convey infection. Could we show that *no* other methods *ever* convey infection it would be a demonstration.

To look at the matter broadly, there are usually three atrie of entrance of an infection: (1) By the alimentary canal; (2) respiratory tract, and (3) abraided or punctured integument. For yellow fever the first is not accused. The negative evidence against conveyance by drinking water is overwhelming, and while that against foods is less so, still it is great, and there is no evidence whatever *for* it so far as I know, and no one claims it.

To exclude the second one. If we could place a certain number of people in an environment infected with yellow fever—i. e., an environment in which cases of yellow fever *were being contracted* (not simply where such cases existed), living in all respects like those who are contracting the disease, but protected against mosquitoes, and these people should fail to contract the fever, it would be evidence that the single factor present in the case of those contracting the fever, but absent in their own—i. e., the mosquitoes puncturing the skins of one set and not of the other, was the cause of the different results in two sets of people. I say “evidence,” and this evidence would be convincing in proportion to (1) the degree of infection of the premises as shown by the proportion of those entering them who contracted the disease and (2) the number of susceptible people exposed and the length of their exposure. It is somewhat strengthened if these same people who escape afterward develop fever from mosquito inoculation; but this is not necessary if enough people are subjected to the experiment. Such evidence would never, strictly speaking, be proof; yet could such an experiment be made in a house like the Grey House, at Orwood, in 1898, where of 32 people who entered the house, some only to stay a few hours, 31 developed yellow fever *from that exposure*, the exposure of a very moderate number of people, not immune to yellow fever, thus isolated from mosquitoes, would be convincing to me. I can conceive of no other test which will *directly* show that conveyance of yellow fever does not take place by the respiratory tract.

We have seen that the theory of conveyance by a host explains all the facts which we know of the conveyance of yellow fever. Does any other theory also explain them? If so, it also has a right to be considered.

It is proven that yellow fever is not in nature transmitted directly from the sick to the well. It is propagated from the sick man by his

infecting his environment, from which only is it contracted by others exposed thereto. This is nowise in accord with the methods of conveyance of known bacterial diseases, all of which are conveyed by material directly from the patient inhaled or injected by, or (as with leprosy) applied to an abraded surface of, the one who receives the infection.

From this it is a *necessary* deduction that the disease is not in nature propagated by material conveyed directly from the sick to the well; that some material after leaving the body of the patient *undergoes some change* outside of his body, and *after* this change produces yellow fever in one susceptible to that disease.

This change, which takes place outside of the body of the sick man, may be:

A. A change in physical condition of the excretion containing the microorganism rendering it able to reach the proper atrium for the infection of others. Analogous to the drying and pulverization of tubercular sputum, etc.

B. The infection of a host, by which host (or its offspring) the microorganism is transmitted analogous to the transmission of malarial fever or the Texas fever of cattle. This may involve no change in the organism itself. It may simply place the organism in a position to enter the human organism by the necessary atrium, as directly into the circulation or lymph spaces. Of course it does not negate such change.

C. A change in the microorganism itself, it undergoing development outside of the human body into some stage different from that in which it leaves the body. This last has been the theory accepted by most of the writers who have considered this subject, but there is no analogy with the propagation of any other disease, so far as is known to the writer.

No other hypothesis is to me conceivable.

Also it is proven that not all environments become infected—i. e., capable of inducing yellow fever in those exposed in them by the presence of people sick of yellow fever; that there are places which become, habitually become, infected if cases of yellow fever be introduced at certain seasons of the year and others which do not and into which the introduction of such cases causes no infection of the environment.

Certain conditions of the environment, then, even in the presence of the yellow-fever patient, are necessary for it to become infected. Besides temperature, moisture, and altitude, there are others of which we are ignorant, and many localities habitually have not received infection from the presence of the sick, although there are no differences in soil or climate, which we could appreciate, between these localities and others that did so become infected.

This quality of a place, its being infectible by yellow fever, sometimes, probably frequently, varies from year to year. Cases of yellow fever may be introduced some summers with impunity, and in others in

the same place spread on introduction. Compare the results at Fer-nandina in 1876 and 1877.

Now, of the three hypotheses, A, B, and C, the first is, I think, not compatible with what is known of the infectibility of places, and which is so well known that we have only alluded to it above. It is not reasonable that the conditions which determine the physical condition of the infective material should be those that we know to influence the infectibility of places, or that they should be so elusive to meteorological tests as the latter have proven.

The third is negatived by the proven fact (Reed and Carroll) that the blood or serum of a yellow-fever patient injected hypodermatically into a well man will produce the disease in him. The microorganism then exists in the blood of the patient, and consequently in the bloody material extruded from him (gums, etc.) in a form capable of producing the disease. No change of development is necessary if it can only be introduced into the circulation directly.

The second hypothesis of the three, which alone seemed admissible, is then the only one not incompatible with the facts which we know of the propagation of yellow fever, and we have seen previously that it is *entirely compatible* with them.

To sum up :

For the belief that yellow fever is conveyed in nature *only* by a host and doubtless a mosquito host, we have—

1. The analogy of other diseases conveyed by insect hosts.
2. That all facts observed about the propagation of yellow fever agree with the necessary deductions of this theory.
3. No other theory explains all the facts observed of its propagation.

The second postulate, may be, I think should be tested further by the collection of other facts to be compared with the theory ; possibly on the lines given above, for obtaining direct negative evidence about this theory of conveyance. Yet the evidence already extant seems to the writer convincing and he is convinced that yellow fever is conveyed in nature *only* by a mosquito host of a particular kind or kinds.

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Treasury Department, Public Health and Marine-Hospital Service.

WALTER WYMAN, Surgeon-General.

VESSELS AS CARRIERS OF MOSQUITOES,

BY

Passed Asst. Surg. S. B. GRUBBS.

MARCH, 1903.

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Section C.—TRANSMISSION.

Asst. Surg. Gen. J. H. WHITE, Chairman of Section.

VESSELS AS CARRIERS OF MOSQUITOES.

By S. B. GRUBBS,

Passed Assistant Surgeon, United States Public Health and Marine-Hospital Service.

At the present time, when evidence is pointing with more and more clearness to the mosquito as the sole means of transmitting yellow fever, nothing is of greater interest to the quarantine officer than to decide to what extent and under what circumstances these infecting insects may be carried by vessels.

This subject may be approached in three different ways: First, by observations on the length of time after leaving infected ports vessels may develop yellow fever; second, by experiments with mosquitoes under artificial conditions made to simulate as much as possible those of nature; and third, by actual observation of vessels arriving from ports at the time infected or where the presence of the *Stegomyia fasciata* render them liable to infection.

While it will require data obtained by all these means and extending over a long period to arrive at any conclusions sufficiently accurate to allow them to influence quarantine procedure, still I believe the last method of observation cited will throw more light on the subject than the first two.

It is for this reason that every vessel arriving at Gulf Quarantine Station from *Stegomyia*-infected ports has, since the 1st of July last, been carefully examined to ascertain if mosquitoes were present on board, and, if present, their variety, where and when they came aboard, and under what conditions.

Gulf Quarantine Station is an especially good point for these observations, from the fact that it is 10 miles from the mainland, and because vessels bound here do not pass near land, and so but rarely take on mosquitoes en route, and even these, as will be seen, are

always the marsh-bred varieties of *Culex*. Besides, the examination of at least a thousand mosquitoes on Ship Island has convinced me that there are no *Stegomyia* here.

Each vessel inspected was carefully searched, the inspector being armed with a cyanide killing bottle, and in addition the captain was asked the following questions:

1. Were there any mosquitoes on board on your outward voyage, consisting of —— days?

2. If so, did they come aboard before departure from home port or at sea, and under what circumstances?

3. Were there any mosquitoes on board at your destination or on homeward voyage?

4. If in port—

(a) How far were you from shore?

(b) Prevailing wind and weather?

5. If on homeward voyage (consisting of —— days)—

(a) Were they from port?

(b) Did they come aboard at sea, on what day, and how far were you from land?

(c) Were there wigglers in any of your tanks at any time?

During the five months from June 1 to November 1 observations were made on 82 vessels, all arriving from ports where the *Stegomyia* is believed to exist in quantities. Of these 78 were sailing vessels and 4 were steamers.

Of these 82 vessels 65 claimed to have had no mosquitoes aboard at any time during the voyage or at port of departure, and their absence having been confirmed by search, we can dismiss them from consideration and pass to the remaining 17.

Five of these had mosquitoes on board at their ports of departure, 2 being rid of them as soon as they were well at sea, while 3 others carried them two days and were then no more troubled, except one schooner on which they reappeared in quantities five days before she reached this port, when she was 20 miles from shore.

Nine sailing vessels, having no mosquitoes on board before sailing, had them appear at sea, in one case from the water casks in which the captain found larvæ. But in the other cases they doubtless came from land which was at the time distant—20 miles in one case, 15 miles in three cases, 10 miles in one case, and 2 miles in the last two instances. In all these vessels the mosquitoes found on board on arrival at this station were the common varieties of *Culex*, there being no *Anopheles* or *Stegomyia* among them.

Stegomyia fasciata were found on board and were identified in the remaining three cases, as follows:

The schooner *Susie B. Dantzler* arrived from Vera Cruz, Mexico, on July 16, 1902, after a voyage of fifteen days. The captain stated

that mosquitoes came aboard in large quantities at Vera Cruz, although he lay a half mile from shore and there were variable winds with squalls and rain all the time. The number of the insects decreased on the voyage but were always in evidence, and we caught four or five of them here. No larvæ were found in any of the tanks, and as the captain had repeatedly examined them without result in his efforts to be rid of the mosquitoes, I believe the insects found on board here came all the way from Vera Cruz.

The schooner *Eleanor* arrived from Vera Cruz on July 17, 1902, thirteen days out. She had no mosquitoes on board before reaching Vera Cruz, but there quantities came on board. Her moorings were half a mile from shore and the winds were variable. The captain stated that he could not get rid of the insects after sailing, although the number decreased very much and there were no larvæ in any of the tanks. At the time of her inspection here we caught and identified a number of *Stegomyia*.

The brigantine *John H. Crandon* arrived at the station July 27, 1902, twenty-two days from Vera Cruz, where she had one case of yellow fever on board. At that port she lay a half mile from the sea wall, three-eighths of a mile from an infected prison, and within 200 yards of an infected vessel. *Stegomyia fasciata* were found on board by Acting Assistant Surgeon Hodgson before she sailed, as well as larvæ in the tanks. All during the trip there were mosquitoes in abundance, and a veritable plague of *Stegomyia* was found on board on her arrival here. There was a constant buzz in the forecastle, and anyone entering was sure to be attacked by several mosquitoes. Specimens were caught in almost every protected part of the vessel, and all were found to be the *Stegomyia fasciata*. The captain had emptied several water barrels because he found they were breeding mosquitoes, but the water remaining had no live larvæ, although many old moults were seen. As breeding was surely going on in the tanks during a part of the voyage at least, it would be impossible to say how long any particular mosquito had been aboard or if any of them had been brought here from the infected port.

SUMMARY.

The above facts may be summed up as follows:

Vessels having no mosquitoes on board at any time	65
Vessels having mosquitoes on board in port of departure	5
Vessels on which mosquitoes (<i>Culex</i>) appeared en route	9
Vessels arriving with <i>Stegomyia fasciata</i> on board	3

Three and a half per cent, then, of all vessels brought *Stegomyia* on a voyage averaging seventeen days.

CONCLUSIONS.

From but one season's observations at a single quarantine station we can not assume to draw any hard and fast conclusions regarding the probability of *Stegomyia*, infected or not, being carried by vessels. Nevertheless, I think we may conclude, first, that mosquitoes can come aboard vessels under favorable conditions when the vessel is not over 15 miles from shore; second, that *Stegomyia* can be carried from Mexican or West Indian ports to those of our Gulf States; third, that they can board a vessel lying at anchor a half mile or less from shore, being conveyed by the open lighters used or flying aboard, and finally, that a vessel moored a short distance from land may become infected with yellow fever, our old beliefs to the contrary notwithstanding.

I wish to acknowledge the aid of Assistant Surgeons Burkhalter and Ebersole in collecting data and specimens.

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